

# **EXHIBIT I**

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12 UNITED STATES DISTRICT COURT

13 NORTHERN DISTRICT OF CALIFORNIA, SAN FRANCISCO DIVISION  
14

15 IN RE SEAGATE TECHNOLOGY LLC  
LITIGATION

16  
17 CONSOLIDATED ACTION  
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21  
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Case No. 3:16-cv-00523-JCS

**DECLARATION OF DONALD ADAMS,  
PE IN SUPPORT OF SEAGATE'S  
OPPOSITION TO PLAINTIFFS'  
MOTION FOR CLASS CERTIFICATION**

**Date:** March 30, 2018  
**Time:** 9:30 a.m.  
**Place:** Courtroom G  
**Judge:** Hon. Joseph C. Spero

Second Consolidated Amended Complaint  
filed: July 11, 2016

24 **UNREDACTED VERSION OF DOCUMENT SOUGHT TO BE SEALED**  
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DECLARATION OF DONALD ADAMS, PE

1. I have been retained as an expert by Defendant Seagate Technology, LLC (“Seagate”) to provide an analysis and rebuttal of the Declaration of Andrew Hospodor (“Hodpodor”) that Plaintiffs submitted in support of their Motion for Class Certification.

2. Specifically, I was asked to evaluate:

- (a) whether the evidence Hospodor cites support his opinions in his Declaration;
- (b) whether Hospodor presented evidence that Seagate's internal, desktop ST3000DM001 products had an AFR above 1% across the class period (2011-2016) and across the different versions of the ST3000DM001 (Grenada Classic, Grenada BP and Grenada BP2);
- (c) whether Hospodor’s opinions are based on sufficient data and are the product of accepted principles of reliability analysis correctly applied to the information and data he cites.

**I. Summary of Relevant Experience**

3. My experience is primarily in the design and development of HDDs since the early 1980’s. I started as an electrical engineer designing magnetic recording data channels while completing my studies in communications systems at Santa Clara University. A significant part of my formal training was in Probability Theory. By the 1990’s I was increasingly responsible for the complete design of HDD products at Maxtor, SyQuest, Quantum and then Maxtor again as a Project Engineer/Manager and Engineering Director. By the early 2000’s I had been the responsible engineer for more than five HDD products from early design, to development and qualification, through transfer to high volume manufacturing. I have contributed to the design of more than ten HDD and related products that have gone into high volume production. At various times throughout my career I have conducted or supervised reliability testing and analysis on hard drives.

4. During this time I also worked on product/technology development and planning. This work led to integration of important technologies to advance areal density, reduce operational costs, and/or develop new applications for HDDs. Of note is the joint development of the Digital Video Recorder with TiVo and other related consumer media products at Quantum. I also led numerous special task forces to resolve critical factory and customer problems for yield and/or reliability which resulted in new design and development processes.

1           5.       Both Dr. Hospodor and I worked at Quantum in the late 1990s and early 2000s where  
2 I was responsible for several HDD products through product qualifications and transfer to  
3 manufacturing. This included reliability testing and analysis. To my knowledge, Dr. Hospodor was  
4 only peripherally involved in this type of work at Quantum.

5           6.       More recently I have continued to work or consult as a senior engineering manager  
6 and electrical engineer. After leaving Maxtor I led the engineering team at Nanochip in a joint  
7 technology development with Intel for probe storage based on MEMS technology and Atomic Force  
8 Microscopy. Since 2009 I have focused mainly on my consulting practice with a four year stint at  
9 Western Digital from 2011 through 2015. During this time, I was involved in defining the  
10 architecture and design of hybrid HDD electronics. This included qualification testing (reliability  
11 testing and analysis) of the first products. I also worked on special problems in signal/power  
12 integrity and Electromagnetic Compatibility.

13           7.       I hold a Master of Science degree in Electrical Engineering (MSEE) from Santa Clara  
14 University and a Bachelor of Science degree in Electrical Engineering (BSEE) from San Jose State  
15 University. I am also a registered Professional Electrical Engineer in California, # E-19198, and  
16 continue to practice in the field.

17           8.       My curriculum vitae is attached as Appendix 1 hereto. The materials I reviewed in  
18 preparing this declaration are listed in Appendix 2.

19           9.       I am presently being compensated for my work in this matter at my current billing  
20 rate of \$350 per hour. My compensation is not dependent on the opinions that I provide or the  
21 outcome of this litigation.

## 22   **II.     Hard Drives and Products at Issue**

23           10.      In 2011, Seagate began manufacturing a computer hard disk drive (“HDD”) bearing  
24 model number ST3000DM001. HDD technology was first developed by IBM in the 1950s to  
25 provide high performance mass data storage for computer systems of that era. It is based on  
26 magnetic recording of bits of data in a layer of material on rotating disks (or “platters”) by means of  
27 a read-write head that flies over the surface of the disks to access the data. Both the size and  
28 capacity of HDDs have evolved since then to provide tremendous capability that enabled

1 widespread personal computing and big-data applications today.

2 11. Within Seagate, the ST3000DM001 was known by the internal codename Grenada.  
 3 (Dewey Decl., ¶ 6.) The Grenada drives had a new, industry leading “areal density” of 1 TB per  
 4 platter at the time. (Dewey Decl., ¶ 22.) The ST3000DM001 was the 3 terabyte (3TB) member of  
 5 the Grenada family, meaning it had 3 platters of 1 TB each. It also had a total of 6 read-write heads  
 6 (2 per platter). There were two other Grenada drive sizes – a 1TB drive with at least 1 platter (and 2  
 7 read-write heads), and a 2TB drive with at least 2 platters (and 4 read-write heads total). (Dewey  
 8 Decl., ¶ 24.) There were three different versions of the Grenada drives, the original Grenada Classic  
 9 that Seagate started manufacturing in 2011, the Grenada Block Point or Grenada BP, which Seagate  
 10 started manufacturing in 2012, and the Grenada BP2, which Seagate started manufacturing in 2014.  
 11 (Ex. 3 [FED\_SEAG0026867] at 26868; Ex. 5 [FED\_SEAG0057277]; Dewey Decl., ¶ 6.) The  
 12 Grenada BP and the Grenada BP2 each had several significant modifications over the prior version.  
 13 (*Ibid.*) Unless otherwise noted, I will use the terms “Grenada drives” and “ST3000DM001 drives”  
 14 to refer to all three versions of the **3TB** Grenada/ST3000DM001 drives.

15 12. The Grenada drives were included in two different groups of products—external,  
 16 USB products (SBS products), and internal, desktop products (Disty products). The external, USB  
 17 (SBS) products are stand-alone backup storage devices that connect to a computer through a USB  
 18 cable.<sup>1</sup> These products contain at least a hard drive, in a separate enclosure or box, USB connectors  
 19 to connect the product to a computer, and usually an independent power supply. The internal,  
 20 desktop products were “bare” drives that users had to install in their own desktop computer or other  
 21 device.<sup>2</sup>

22  
 23  
 24 <sup>1</sup> These products are the Desktop External Drive, BackUp Plus Mac, BackUp Plus Desk,  
 25 FreeAgent GoFlex Desk, FreeAgent GoFlex Home, GoFlex Desk for Mac, FreeAgent GoFlex  
 Home, Expansion Desk, Expansion Desk Plus. That Hospodor cites in his paragraphs 23 and 26.  
 See e.g., Hospodor Decl., ¶¶ 23, 26, and footnote 3.

26 <sup>2</sup> The “Disty” drives were sold for use as internal, desktop hard drives. This means they  
 27 were sold as drives without any external box or enclosure of their own and needed to be installed  
 into desktop computers or backup systems by consumers. These products were the Barracuda and  
 Desktop HDD Internal Kit drives. See e.g., Hospodor Decl., ¶¶ 23, 26, and footnote 3. The Desktop  
 28 HDD Internal Kit was the replacement name for the Barracuda. Both were “Disty” products.  
 (Dewey Decl., ¶ 7.)



13. It is my understanding that Plaintiffs define the relevant period (the “class period”) as from the earliest release of the ST3000DM001 drives to February 1, 2016. (Hospodor Decl., footnote 1.) Since the first version of the ST3000DM001 drives was first approved for release as an external, USB product in April, 2011 (Ex. 1 [FED\_SEAG0026697]), I assume the proposed class period to be April, 2011 – February, 2016.

14. Unless otherwise noted, Exhibits referred to in this declaration are Exhibits to the Declaration of Liên Payne filed concurrently herewith.

### III. Summary of Opinions

15. There are numerous problems with the opinions expressed in Dr. Hospodor’s declaration. Specifically:

- A. Hospodor fails to support his claims that the ST3000DM001 drives had a higher than advertised AFR;
- B. Hospodor’s claim that Seagate’s testing “underestimated” the “true” AFR of the drives makes no sense, and is based on misinterpretation of Seagate’s documents and misapplication of principles of failure analysis;
- C. Hospodor fails to support any conclusion that Seagate’s internal, desktop ST3000DM001 products had an AFR above 1% across the class period and across different versions of the ST3000DM001 (Grenada Classic, Grenada BP and Grenada BP2), or that the ST3000DM001 drives had any problem common throughout the class period (2011-2016), or common to the products and drive versions at issue;
- D. Hospodor fails to support the claim that Seagate’s reliability testing and quality control process were flawed;
- E. Hospodor does not justify the claim that the ST3000DM001 drives (Grenada Classic, BP and BP2) were released for production before the design and manufacturing process were properly qualified to meet product and business goals, and unreasonably concludes the ST3000DM001 was inherently ‘unstable’ and ‘unreliable’;
- F. On the whole, Hospodor’s opinions are not based on sufficient data and are not the product of accepted principles of reliability analysis correctly applied to Seagate’s data;

#### **A. Hospodor fails to support his claims that the ST3000DM001 drives had a “higher than advertised” AFR.**

16. Hospodor claims that Seagate’s documents show that “the Drives” had a projected AFR that was “higher than advertised.” Hospodor’s opinions are based entirely on analyzing documents written and produced by Seagate. He does not report having performed any testing or



1 analysis of ST3000DM001 drives, or made any attempt to independently determine the failure rate  
 2 of any of the drives. Hospodor's opinions rest on misinterpreting or misrepresenting Seagate's  
 3 documents, and are not supported by the evidence he cites. As explained above, there are two  
 4 different groups of products at issue—external, USB products (SBS products), and internal, desktop  
 5 products (Disty products), and three different versions of the Grenada drive (Classic, BP and BP2).

6 a. **External, USB (SBS) Products:** The bulk of Hospodor's analysis is  
 7 confined to **SBS products**, and attempting to show that when the Grenada Classic and  
 8 Grenada BP were released *for use in SBS products*, the drives had a higher than 1% AFR.  
 9 However, Seagate did not publish an AFR for SBS products, so his analysis is misplaced,  
 10 and cannot support his conclusion that “the Drives” had a “higher than advertised” AFR.  
 11 (See Sections VI.A below.) Furthermore, I have reviewed all the evidence Hospodor cites  
 12 concerning the SBS products, and in my expert opinion, it cannot support a conclusion that  
 13 Seagate's testing or specifications for drives used in SBS products was flawed or inadequate.  
 14 (See e.g., Sections IV.D, IV.E, VII below.)

15 b. **Internal (Disty) Products:** With regard to the internal (Disty) products, the  
 16 evidence available to me indicates that Seagate's AFR statements varied among products and  
 17 changed over time. The evidence Hospodor cites indicates that, at most, Seagate published a  
 18 0.34% AFR for the internal, desktop products for approximately 4 months. (See Section V  
 19 below.) The remainder of the time it appears Seagate either published no AFR for these  
 20 products, or sometimes published an AFR of “<1%”. (*Id.*)

21 c. However, the documents Hospodor cites show that Seagate *demonstrated* that  
 22 the Grenada Classic, Grenada BP and Grenada BP2 used in internal (Disty) products *had*  
 23 *AFRs<sup>3</sup> of <1%*. (Ex. 2<sup>4</sup> [FED\_SEAG0026839] at 26844 (Grenada Classic AFR was 0.95%);  
 24 Ex. 4 [FED\_SEAG0026751], at 26783 (Grenada BP AFR was 0.98%); Ex. 5  
 25 [FED\_SEAG0057277], at 57324 (Grenada BP2 AFR was 0.9%).)

26 <sup>3</sup> As explained further below, the AFRs discussed in this declaration are *projected* AFRs  
 27 based on accelerated testing of populations of hard drives. Accordingly, I use the terms “AFR” and  
 “projected AFR” interchangeably.

28 <sup>4</sup> As noted, exhibits referred to in this declaration are Exhibits to the Declaration of Lien  
 Payne, filed herewith.

d. Hospodor does not present any evidence that the Grenada BP or BP2 internal (Disty) drives ever had AFRs over 1%.<sup>5</sup> Hospodor cites two documents showing an AFR for internal, desktop (Disty/OEM) Grenada *Classic* drives above 1% *at two points in 2012*. (Section VI.C.) However, the Grenada Classic drives were subject to “ship holds” at those times, so those drives were not being shipped to customers. (*Id.*) Hospodor does not present any evidence that Grenada Classic internal (Disty) drives (or Grenada BP or BP2 Disty drives for that matter) were ever shipped to consumers with an AFR over 1%.

**B. Hospodor’s claims that Seagate’s testing underestimated the “true” AFR of the drives is based on misinterpretation of Seagate’s documents and misapplication of principles of failure analysis.**

17. Hospodor appears to argue that even if Seagate's test data showed AFR of below 1% for the internal, Disty drives, Seagate's methods of calculating AFR was flawed and underestimated the “true” AFR of the drives. Hospodor claims that Seagate ‘*selected*’ (or used a pre-selected) Beta value of less than 1 to calculate projected AFRs, when in fact (according to Hospodor) Seagate should have used a Beta value of greater than 1.<sup>6</sup> Hospodor's assertion that Seagate should have used a different value of Beta isn't supported by an accepted methodology or the evidence he cites.

18. As a preliminary matter, Hospodor incorrectly claims that Seagate ‘selected’ or ‘assumed’ a Beta value for the Weibull distribution in order to calculate the predicted AFR for the Grenada drives. This is incorrect. It is apparent from Seagate's documents, and Seagate's witness's prior deposition testimony and declarations, that Seagate **always** used industry-standard techniques (maximum likelihood estimation or MLE) to estimate Beta, Eta and to calculate the predicted AFR *from actual test data for all ST3000DM001 products*. (See Section IV.B below.) *Seagate did not select or assume Beta*. Thus, in this regard, Hospodor's criticism of Seagate's methodology is baseless.

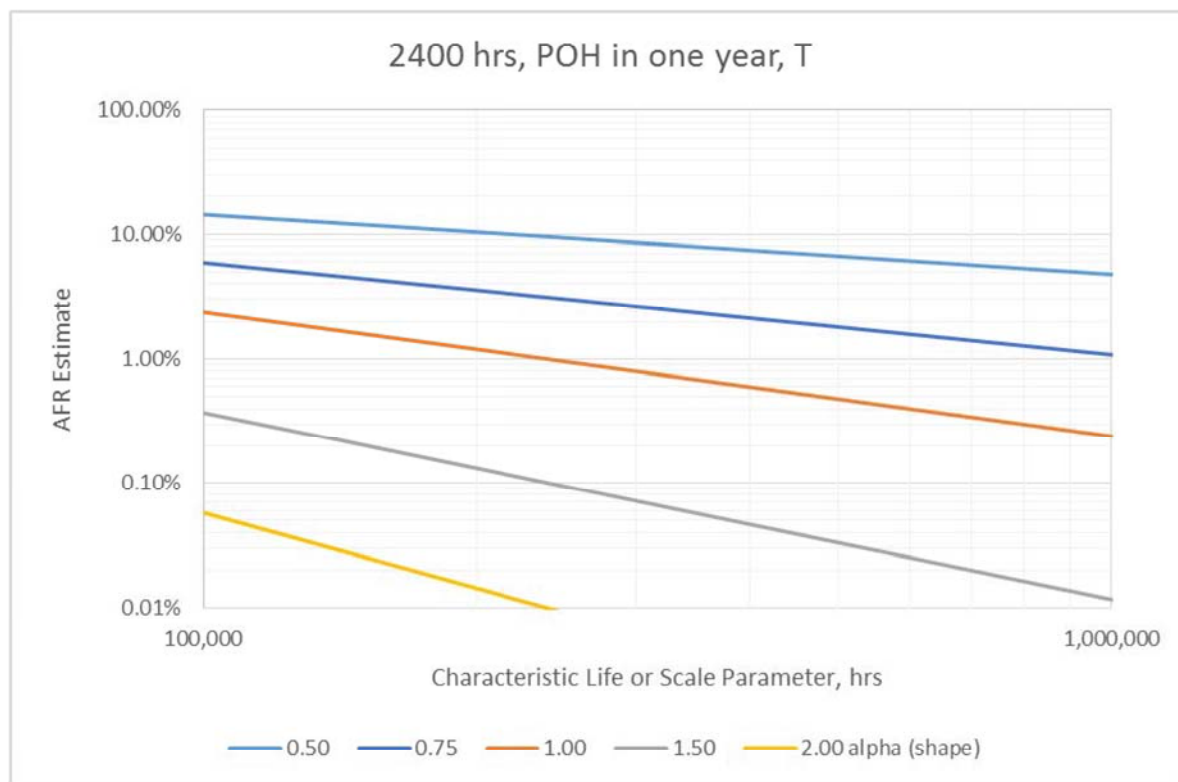
<sup>5</sup> As explained below, any attempt to reference higher AFRs simply misreads the documents an improperly uses AFRs that do not reflect the drives shipped to consumers. (Section VI.B.)

<sup>6</sup> Beta is a reference to the “shape” parameter of the Weibull distribution, which is a mathematical function or distribution that is used to model the probability of product failures over time in use (or ‘age’ of the products). As explained below, the Weibull distribution has at least two parameters, Eta, the characteristic life or scale parameter, and Beta the shape parameter.

1           19.       Furthermore, Hospodor's claim rests on three alleged pieces of evidence: (1) an  
 2 alleged sequence of three AFRs from different test populations of Grenada Classic drives; (2) a  
 3 powerpoint presentation by Seagate employee Andrei Khurshudov; (3) a test report document for  
 4 the Grenada BP2 drives. None of these pieces of evidence support his assertion that Seagate should  
 5 have used a Beta value of greater than 1 to calculate the predicted AFR for the Grenada drives.  
 6 Hospodor's analysis of the first piece of purported evidence is based on misrepresenting Seagate's  
 7 data and misapplying Weibull analysis to that data. (Section VII.C.1, below.) Hospodor's attempt  
 8 to rely on Khurshudov's powerpoint fails for many reasons, including that Khurshudov testified his  
 9 conclusions did not apply desktop products like Grenada (and in fact, his report showed *Beta*  
 10 *consistently less than 1 for such products*), and Khurshudov makes unfounded if not incorrect  
 11 conclusions about the value of Beta that Hospodor adopts. (Section VII.C.2, below.) Hospodor's  
 12 claims regarding the third piece of evidence are based on an unfounded (and unsound) interpretation  
 13 of a Seagate document. (Section VII.C.3, below.)

14           20.       Most importantly, perhaps, Hospodor's criticism makes absolutely no sense. It rests  
 15 on the entirely false assumption that because Seagate used a  $\text{Beta} < 1$ , Seagate *underestimated* the  
 16 "true" AFR of the drives, *and if* Seagate had instead used a  $\text{Beta} > 1$ , Seagate's calculations would  
 17 show a higher predicted AFR. This is not accurate. Using Beta > 1 will result in a lower  
 18 projected AFR for any given test population, especially for the first year, as shown in Figure 1  
 19 below. This graph has different values of Eta (the characteristic life or scale parameter) along the  
 20 bottom, x-axis, and AFR along the vertical, y-axis. The graph shows that the line for  $\text{Beta} = 0.5$   
 21 (light blue line) is always above the other lines—corresponding to the highest AFRs for any given  
 22 value of Eta. The lines for  $\text{Beta} = 1.0$ ,  $1.5$  and  $2.0$  correspond to *progressively lower* AFRs. In  
 23 other words, if Seagate had assumed a Beta value greater than 1, as Hospodor insists Seagate should  
 24 have done, this would have *lowered* the predicted AFR that Seagate reported in the documents he  
 25 cites. (See also Section VII.B.)





**Figure 1.** First year AFR using the Weibull distribution for different scale and shape parameters. (Figure prepared using Excel and Excel's Weibull function.)

**C. Hospodor fails to support any conclusion that Seagate's internal, desktop ST3000DM001 products had an AFR above 1% across the class period and across different versions of the ST3000DM001 (Grenada Classic, Grenada BP and Grenada BP2), or that the drives had any problem common throughout the class period (2011-2016), or common to the products and drive versions at issue.**

21. I have been asked to evaluate whether Hospodor's evidence demonstrates that internal (Disty) drives had an AFR above 1% throughout the class period (which Hospodor defines as from the release of the Grenada drives (2011) to February, 2016) or across different versions of the drives (Grenada Classic, Grenada BP, Grenada BP2). Hospodor does not provide any such evidence. The evidence shows that at the time of release of each version of the drive for use as internal (Disty) products, Seagate had tested a large population of drives and appropriately calculated AFRs below 1% for each of the Grenada Classic, Grenada BP, Grenada BP2 versions of the drives. (Figure 2 and Section VI.B.)

22. Hospodor cites only two categories of documents that could show higher than 1% AFRs. First, Hospodor cites documents concerning Grenada Classic and BP drives used in external,



1 USB (SBS) products. However, Seagate did not advertise an AFR for these products, and so these  
 2 documents do not support his conclusions.<sup>7</sup> Second, Hospodor points to two documents apparently  
 3 showing two periods in 2012 when testing (for less than the full 6 weeks) produced projected AFRs  
 4 of above 1% for the Grenada *Classic* drives. (Section VI.C below.) However, at the time of these  
 5 documents, the drives were subject to “ship holds” and not being shipped to consumers, so the  
 6 documents do not show that drives shipped to consumers had a projected AFR above 1%. (*Ibid.*)  
 7 Moreover, this evidence is *limited* to the Grenada *Classic* drive *in 2012*. (*Ibid.*)

8 23. None of the other evidence Hospodor cites (yields, ECRs, etc.) can be used to  
 9 determine whether AFR was above 1%. (Paragraphs 83, 89, 97, 103, Netel Decl., ¶¶ 28-39.) At any  
 10 rate, with one exception, Hospodor’s other evidence is limited to Grenada Classic drives in 2011-  
 11 2012. Thus:

- 12 • Hospodor’s yield discussion is limited to Grenada Classic in 2011 and 2012. (Paragraph 84  
 13 below.) To the extent Hospodor discusses Grenada BP, the data consists of *pre-release* yield  
 information for Grenada BP in 2012. (*Id.*)
- 14 • Hospodor’s analysis of ECRs is based on Grenada Classic ECRs in 2011 and 2012.  
 15 (Paragraphs 90 below.) Although Hospodor claims there were a high number of ECRs for  
 Grenada BP, he fails to provide supporting evidence or analysis. (*Ibid.*)
- 16 • The ship holds Hospodor cites are from 2011-2012, and with one exception, relate to  
 17 Grenada Classic. (Paragraphs 103 below.)
- 18 • The Backblaze blog posts should not be credited, but even if they were, Backblaze purchased  
 19 over 80% of its drives before September 2012, so Backblaze’s blog posts do not shed light  
 20 on drives manufactured after 2012. (Section VII.D below.)

21 The one exception appears to be the Apple recall, but even this was related to products  
 22 manufactured before May 2013 and drives sold to OEMs such as Apple are not at issue in this case.  
 23 Among other things, the Apple use environment is not evidence of how the drives performed in  
 24 other environments. (Paragraph 106 below.)

---

25 <sup>7</sup> Even as to this evidence, it would only apply to the Grenada Classic and BP SBS drives  
 26 *for relatively short periods of time* before the qualification of the corresponding Grenada Classic  
 27 and BP Disty drives. Seagate did not maintain different manufacturing lines for SBS as opposed to  
 28 Disty/OEM drives. (Dewey Decl., ¶ 8.) Once Seagate qualified the Disty/OEM drives any  
 reliability improvements observed for those drives would apply equally to SBS drives unless there  
 were some special circumstance preventing such application. But Hospodor does not cite any  
 documents showing that AFR of SBS products was higher than the AFR of Disty products after the  
 release of the Disty products.

24. Finally, as Hospodor admits, he does not identify any problem common throughout the class period (2011-2016), or common to the products and drive versions at issue (Classic, BP, BP2). (Ex. 11 [Hospodor Depo.] at 49:7-50:3; 50:23-51:3; 52:7-25.) Hospodor's references to "head related" and "contamination" "issues" are not technically sound, lacks evidence, and are irrelevant. (See Section IX.) If anything, Hospodor's comments about these "issues" suggest he does not understand modern hard drive operation or failure modes.

**D. Hospodor fails to support the claim that Seagate's reliability testing and quality control process were flawed.**

25. I have examined Seagate's Product Life Cycle Process Drive Development Overview and various program review summaries. (FED\_SEAG0027285, Exhibits 1-4; *see also, e.g.*, Hospodor Figure 1.) I found them to be consistent with my experience and industry practice in the computer and HDD business. Seagate has also maintained ISO 9000 certifications continuously since 1996 or earlier. (See Section IV.E.) Hospodor argues that Seagate's reliability testing processes were flawed because Seagate did not use a Beta of greater than 1, or did not test the drives for longer than 6 weeks. These claims are not supported by evidence nor by valid methodology, as explained below. (Section VII.) Hospodor also appears to claim that Seagate's quality control processes were flawed because the number of engineering change requests ("ECRs") and firmware releases was 'too high' (in Hospodor's opinion), or Seagate's yield was 'too low' (in Hospodor's opinion). As explained below, these opinions rest on misreading or misrepresentations of Seagate's documents, and Hospodor's apparent lack of understanding of current HDD design and manufacturing methods. (Sections VIII.A, VIII.B.)

**E. Hospodor does not justify the claim that the ST3000DM001 drives (Grenada Classic, BP and BP2) were released for production before the design and manufacturing process were properly qualified to meet product and business goals, and unreasonably concludes the ST3000DM001 was inherently 'unstable' and 'unreliable'.**

26. As noted above, Seagate's test data and documents do not support Hospodor's conclusion that the drives had a higher than advertised AFR or were released early. Lacking any further support from actual AFR data, Hospodor turns to analyzing other aspects of Seagate's drive development process and claiming they show that the Grenada drives were released for production



1 before the design and manufacturing process were properly qualified, or that the drives were  
2 “unstable” or “unreliable.” Hospodor looks at yields, engineering change requests (“ECRs”), ship  
3 holds, and information about an Apple recall, and claims they show the drives were “unstable,”  
4 “unreliable,” or that the drives were released before being properly qualified.

5         27. It is important to note that none of Hospodor's claimed evidence (yield, ECRs, ship  
6 holds, Apple recall) show that any drives sold to the public had an AFR over 1%. (Paragraphs 83,  
7 89, 97, 103, 106, Netel Decl., ¶¶ 28-39.) As Hospodor admitted, these types of evidence cannot be  
8 used to determine the AFR for hard drives. Thus, these purported additional pieces of evidence do  
9 not support Hospodor's conclusions that the drives sold to consumers had an AFR that was “greater  
10 than advertised” or greater than 1%.

11         28. Furthermore, Hospodor relies on evidence regarding yield, ECRs and firmware  
12 revisions does not support his conclusions that the drives were released prematurely or that they  
13 were unstable or unreliable. For example, Hospodor claims the number of ECRs shows that the  
14 drives were unstable and released prematurely. Yet he offers no comparison by which to judge this  
15 conclusion. In my experience the number of ECRs needed to develop and release a new product is  
16 typically large, especially for a new capacity point or increased areal density. (Paragraph 94 below.)  
17 The ST3000DM001 was one of the first, if not the first, consumer desktop HDD to reach 1 TB/disk  
18 areal density. It certainly was Seagate's first such product. Furthermore, in my experience with  
19 modern drive development processes, it is not uncommon to qualify suppliers and sources after  
20 initial release and during the ramp of production of a product. (*Id.*) Thus, there is nothing  
21 noteworthy about the number or timing of the ECRs for the Grenada drives. (*Id.*) At best,  
22 Hospodor's opinions are based on very outdated drive manufacturing processes, and lower volume  
23 manufacturing with less complex supply chains. (*Id.*) The evidence Hospodor relies on regarding  
24 yield and firmware revisions does not support his opinions. (Sections VIII.A, VIII.C below.)

25         29. Similarly, Hospodor's purported evidence regarding ship holds and returns also does  
26 not support Hospodor's conclusions that consumer drives were released prematurely or that they  
27 were unstable or unreliable. Among other things, the ship holds Hospodor cites are from 2011-  
28 2012, and with one exception, relate only to Grenada Classic—they cannot support any conclusions

1 about Grenada BP or Grenada BP2 drives or drives manufactured at any later point in time.  
 2 (Paragraph 103 below.) Furthermore, Hospodor's discussion of ship holds is logically flawed.  
 3 Seagate issued ship holds whenever it detected a possible problem to prevent drives from reaching  
 4 consumers before they were ready. Ship holds are not evidence that flawed or high AFR drives  
 5 reached consumers; they are the opposite. (Paragraph 104 below.)

6 **F. Hospodor's opinions are not based on sufficient data and are not the product of**  
 7 **accepted principles of reliability analysis correctly applied to Seagate data.**

8 30. As explained in this declaration, Hospodor consistently misrepresents and  
 9 misinterprets Seagate's documents. The documents themselves do not support Hospodor's  
 10 conclusions. (*See e.g.*, Sections VI, VII, IX and Paragraphs 39, 86 95, 100, 101.) Moreover,  
 11 Hospodor misunderstands and misapplies accepted principles and methods of reliability analysis,  
 12 and advocates approaches that are unreliable and completely unsupported. (See Section VII.)  
 13 Hospodor also applies norms of hard drive manufacturing that are several decades out-of-date. .  
 14 (See Paragraphs 86 94.) There is not a single section of Hospodor's declaration that does not exhibit  
 15 one or more of these problems. None of Hospodor's opinions are supported by sufficient actual  
 16 data, and none result from applying reliable or accepted methods or principles to actual data.

17 **IV. Reliability Testing, AFR, and Seagate's Drive Development Process**

18 **A. Data from Reliability Testing Is Used to Estimate the Weibull Distribution**  
 19 **Parameters and Calculate Projected AFR (and MTBF)**

20 31. AFR is commonly called Annualized Failure Rate and is a measure of reliability  
 21 widely used in the hard disk drive ("HDD") industry. As such it is a probability of failure for a  
 22 population in any given year, and should not be confused with instantaneous failure rate (or formally  
 23 hazard function). The latter is a conditional probability of failure given survival to a specific time  
 24 with units of #failures/sec. AFR is unitless and typically expressed as a percent.

25 32. AFR is typically calculated in the following manner. A sample population of hard  
 26 drives is subjected to "accelerated" testing (which Seagate called reliability demonstration testing or  
 27 "RDT"). This means the drives are operated at high stress (high workloads and high temperature) to  
 28 produce physical failures. The high stress "accelerates" the physical failures so that the testing  
 produces in a short amount of time the same failures that would happen during normal use over a



1 longer amount of time.<sup>8</sup> The data obtained from this testing includes the time-to-failure of the  
 2 drives that failed, and the amount of time in testing for the drives that did not fail.

3 33. In my experience, typical reliability testing involves testing about 1,000 HDDs for  
 4 1,000 hours or more. Seagate's RDT involved testing approximately 1,000 drives for at least six  
 5 weeks or 1,008 hours, at maximum workload. (See Ex. 4 [FED\_SEAG0026751] (1068 drives for  
 6 1009 hours); Ex. 5 [FED\_SEAG0057277] at 57324 (1058 drives tested for 1197 hours); Almgren  
 7 Decl., ¶ 6.) In testing the drives at maximum workload for six weeks Seagate subjected the drives to  
 8 the equivalent of between *3 to 3.8 years of use* during testing. (*Ibid.*) Since Seagate also subjected  
 9 the drives to high temperatures during RDT, (15-20° C hotter than the typical field applications),  
 10 this would further accelerate wear on the drives, and increase the coverage of the test to 3-4 years or  
 11 more of typical wear. As explained further below, Seagate used the same testing protocol for post-  
 12 release, ongoing reliability testing ("ORT"). (Netel Decl., ¶ 13, 14; Paragraph 48, below.)

13 34. A distribution (or function) is then used to model the failure information (or "life  
 14 data") obtained from RDT testing and to calculate a predicted MTBF and AFR as described further  
 15 below. The goal of fitting a distribution is to create a model of failure rates or probabilities as a  
 16 function of the time that the products are used (the age/life of the products). The two parameter  
 17 Weibull function is the most common probability distribution function (pdf) used for reliability in  
 18 my experience for HDDs.<sup>9</sup> In fact, reliability analysis is often called Weibull analysis because this  
 19 model is so popular for describing failure behavior. It is very flexible and empirically successful in  
 20 fitting life data with different types of failure rate behavior, including the three failure patterns  
 21 (higher 'early life' failures with decreasing failures over time, constant or random failures, and end  
 22  
 23

---

24 <sup>8</sup> See, e.g., National Institute of Standards and Technology ("NIST")/SEMATECH e-  
 25 Handbook of Statistical Methods (herein after "NIST Handbook"),  
 26 <http://www.itl.nist.gov/div898/handbook/>, 10/30/2013; section 8.1.4 "What is "physical  
 acceleration" and how do we model it?" at  
<http://www.itl.nist.gov/div898/handbook/apr/section1/apr14.htm>.

27 <sup>9</sup> See NIST Handbook, Section 8, "Assessing Product Reliability" at  
<http://www.itl.nist.gov/div898/handbook/apr/apr.htm>; "Life Data Analysis Reference" produced by  
 28 ReliaSoft Corporation in Tucson, Az., 5/22/2015, <http://www.ReliaSoft.com>; "An Introduction to  
 Applied Probability", Ian F. Blake, 1979; Chapter 12, "Reliability Theory," page 357.

of life or wear out) that comprise the so called ‘bathtub curve.’<sup>10</sup>

35. The Weibull function has at least two parameters, the “scale” or “characteristic life” parameter Eta ( $\eta$ ) and the “shape” parameter Beta ( $\beta$ ).<sup>11</sup> The scale parameter, Eta, defines where the bulk of the distribution lies, while the shape parameter Beta describes the general shape of the distribution. In general, a Beta of less than 1 ( $<1$ ) means that the failure rate is decreasing with the age or time in use of the products, a Beta of 1 means that the failure rate is constant over age (time in use), and a Beta of greater than 1 ( $>1$ ) means the failure rate is increasing with age (time in use). There is an analogy to human populations, where Beta could be thought of as describing whether the probability (or rate) of deaths increases or decreases *as a population ages*. (e.g., Does the population have high infant mortality with decreasing probability of death after infancy? Or do 40 year-olds have a higher probability of dying than 10 year-olds?) In the human context, Beta  $> 1$  would describe an increasing probability of death *with age*. Beta  $>1$  would describe, e.g., a situation in which 40 year-olds have a higher chance of dying than 10 year-olds. The “AFR” would be the annualized probability of dying *at any given age*.

36. However, Beta does not control the actual value of the AFR—one could have an AFR of 0.01% or 20% and a Beta  $>1$  or equal to 1 or  $<1$ . Furthermore, as explained in paragraph 20 above, and as shown in Figure 1, a Beta  $< 1$  will result in a higher projected AFR for any given characteristic life (Eta), especially for the first year.

37. By contrast, the characteristic life or scale parameter is just as important to determining AFR, and cannot be ignored as Hospodor does. Among other things, the Weibull distribution has two parameters and both are necessary to calculate the predicted AFR. One can’t just ignore “half the equation” (so to speak) as Hospodor does. Furthermore, Eta has an important impact on the resulting AFR. As shown in Figure 1, for a Beta value of 0.75, a 10x increase in the characteristic life (from 100,000 hours to 1 million hours), results in approximately a *10x decrease in AFR*. (See Figure 1, dark blue line. The vertical, or y-axis is on a log scale.) For a Beta value of

<sup>10</sup> See NIST Handbook, section 8.1.2.4 “‘Bathtub’ curve” at <http://www.itl.nist.gov/div898/handbook/apr/section1/apr124.htm>; chapter 8.1.6.2., “Weibull” at <http://www.itl.nist.gov/div898/handbook/apr/section1/apr162.htm>.

<sup>11</sup> See e.g., <http://www.weibull.com/basics/parameters.htm>.

1 >1, the effect of changes to Eta are even more dramatic. (Additionally, more improvement of the  
 2 characteristic life (Eta) is needed to achieve an AFR target when the shape parameter is lower, <1.)  
 3 The effect is similar when looking at total failure probabilities (FR) over 5 years.

4 **B. Seagate Always Estimated the Weibull Parameters and Calculated the Projected**  
 5 **AFR for the Grenada Drives from Actual Test Data – It Did Not “Assume” Beta**

6 38. In paragraph 38, Hospodor says: “Data obtained during testing is used to calculate  
 7 the beta parameter of the Weibull distribution, and the beta is then used in projecting AFR.”  
 8 However, in other parts of his declaration Hopodor repeatedly claims or assumes that Seagate  
 9 selected, used a pre-selected or ‘assumed’ a Beta <1 when Seagate was calculating AFRs.  
 10 (Hospodor claims this was inappropriate, that it resulted in Seagate underestimating the ‘true’ AFR,  
 11 and that Seagate should have used a Beta > 1.) As explained below, each part of Hospodor’s  
 12 reasoning is flawed. Seagate did not ‘select’ or ‘assume’ a Beta of <1 for the Grenada drives. In  
 13 fact, Seagate always used reliability test data to estimate both the characteristic life, Eta, and shape  
 14 parameter, Beta, for use in the Weibull distribution and calculating AFR. (See Almgren Decl., ¶ 8-  
 15 10; Ex. 13 [Almgren Depo.] at 182:8-183:10, 185:4-186:6; Netel Decl., ¶ 18.)

16 39. Indeed, it is apparent from the Seagate documents Hospodor cites that Seagate  
 17 always used MLE to estimate Beta (and calculate projected AFR values) from actual reliability  
 18 testing on Grenada drives. The Seagate documents state that the AFR is “From all fails Weibull  
 19 MLE”—clearly indicating that the AFR is obtained from maximum likelihood estimation (MLE) on  
 20 the failures that occurred during actual testing. (Ex. 1 [FED\_SEAG0026697] at 26704, Ex. 2  
 21 [FED\_SEAG0026839] at 26844; Ex. 3 [FED\_SEAG0026867] at 26887; Ex. 4  
 22 [FED\_SEAG0026751] at 26783; Ex. 5 [FED\_SEAG0057277] at 57324.) Furthermore, the number  
 23 of drives tested and time in testing is listed in each document. (*Ibid.*) The Beta value is given and it  
 24 varies from test to test (from document to document) and is often expressed out to 6 or 7 places past  
 25 the decimal point. (*Ibid.*) All of these factors are obvious indications that Seagate calculated the  
 26 predicted AFR (and Beta) using MLE based on actual test data from Grenada drives.<sup>12</sup> The Beta,  
 27 and AFR values Seagate calculated, and the corresponding test population are shown in Figure 2

28 <sup>12</sup> In each case, Seagate confirmed that the Beta value was less than 1 based on the actual  
 test data. (*Ibid.*)



below. Furthermore, at least one of Seagate's employees testified that that Seagate determined AFR and Beta from actual test data. (Ex. 13 [Almgren Depo.] at 182:8-183:10, 185:4-186:6.) Given these facts, Hospodor's repeated insistence that Seagate 'assumed' or 'selected' Beta of less than 1 is inexplicable and demonstrably wrong.

Exhibit, page	Drive / Product	Test Date	# of drives tested	Av Hrs tested	Beta	Demo'd MTBF	Demo'd Reduced AFR	Raw AFR
Ex. 1 26704	Grenada Classic / SBS	4/27/11	1651	740	0.608098	101,000	2.340%	7.006%
<b>Ex. 2 at 26844</b>	<b>Grenada Classic / Disty</b>	<b>10/17/11</b>	<b>1360</b>	<b>953</b>	<b>0.63955018</b>	<b>251,000</b>	<b>0.950%</b>	<b>2.621%</b>
Ex. 4 at 26785	Grenada Classic / Disty (ORT Testing)	6/4/12	N/A	535	0.506781	100,000	2.350%	3.436%
Ex. 3 at 26887	Grenada BP / SBS	4/12/12	1068	661	0.4819208	118,000	2.000%	2.942%
<b>Ex. 4 at 26783</b>	<b>Grenada BP / Disty</b>	<b>5/14/12</b>	<b>1068</b>	<b>1009</b>	<b>0.4756772</b>	<b>243,000</b>	<b>0.980%</b>	<b>2.917%</b>
<b>Ex. 5 at 57324</b>	<b>Grenada BP2 / Disty</b>	<b>1/14/14</b>	<b>1058</b>	<b>1197</b>	<b>0.394</b>	<b>267,000</b>	<b>0.90%</b>	<b>1.039%</b>

**Figure 2** Results of Seagate reliability testing cited by Hospodor. Results for internal, desktop (Disty) releases are in blue text. The first 3 lines concern Grenada Classic drives, the next two concern Grenada BP drives and the last Grenada BP2. All AFR estimates use an assumed 2400 POH/year (the only assumption). (Ex. 1 [FED\_SEAG0026697] at 26704, Ex. 2 [FED\_SEAG0026839] at 26844; Ex. 3 [FED\_SEAG0026867] at 26887; Ex. 4 [FED\_SEAG0026751] at 26783, 26785; Ex. 5 [FED\_SEAG0057277] at 57324.)

40. In paragraph 38, Hospodor also claims that “[a]s discussed in more detail in Section H, the Weibull beta calculated by Seagate did not match the true failure characteristics of the ST3000DM001, which demonstrates that Seagate’s testing was flawed and underestimated the true AFR of the Drive.” As explained further below, Hospodor provides no evidence in his Paragraph 38 or later in his Section H for his claim that “Seagate’s testing was flawed and underestimated the true AFR of the Drive.” Furthermore, Seagate used industry-standard software and well-established maximum likelihood estimation (MLE) methods to obtain the Weibull parameters from actual test



1 data on the drives. In this sense, Seagate's estimated Beta and Eta parameters, (and AFRs) do and  
2 must reflect the failure characteristics for the ST3000DM001 drives.

3 **C. Hospodor Makes Several Misstatements about AFR and MTBF in His Sections**  
4 **IV.C.1 and IV.C.2.**

5 41. Hospodor's description of AFR and MTBF contain a few notable errors. Together  
6 with errors elsewhere in his report and in his deposition, it does not appear that Hospodor fully  
7 understands reliability analysis, and in particular does not understand the Weibull analysis or the  
8 significance of the parameters Beta and Eta:

9 a. As explained above, both Eta and Beta are required along with the assumed  
10 number of POH per year to project an AFR. Throughout his declaration, Hospodor  
11 consistently ignores Eta, which is improper.

12 b. In Paragraph 27, Hospodor claims that "common" failure modes for "the  
13 ST3000DM001" were "contamination and head-related failures" and *implies* (but does not  
14 claim) that these failure modes are not "independent" and *implies* (but does not claim) that  
15 because of this, it was improper for Seagate to use the Weibull distribution to project AFR.  
16 Statistical independence is important to the estimation of life parameters for the Weibull  
17 distribution. But multiple failure modes does not imply dependence of failure times, and  
18 Hospodor provides no basis for believing that the failure modes he discusses are statistically  
19 dependent. In particular, *Hospodor cites no evidence* or reason to believe that different  
20 contamination-related failures, or different head-related failures, are causally related or  
21 statistically dependent. Accordingly, Hospodor's discussion of "contamination" and "head  
22 related" failures does not support any conclusion that Seagate improperly utilized the  
23 Weibull distribution to estimate AFR. Rather, as discussed in Section IX below, his repeated  
24 references to "head related" failures and "contamination" issues do not point to any sort of  
25 common problems or issues because "head related" and "contamination related" failures are  
26 broad categories, with myriad unrelated potential causes.<sup>13</sup>

27 <sup>13</sup> Certainly the possible existence of multiple failure modes complicates the data analysis.  
28 But Seagate demonstrates their ability to separate them out even if they do not go so far as to  
estimate the life parameters for each. The methods for doing this are well known and there are

c. In Paragraph 28 Hospodor defines MTBF as “mean time between failure.” Strictly speaking MTBF means Mean Time *Before* Failure as used for HDDs. (It is literally the statistical mean or average time to failure over a specified time interval, zero to infinity.) Mean Time Between Failure is used for systems or components that can be repaired. Usually HDDs are not repaired.

d. As Hospodor acknowledges in Paragraph 33, the AFR is not necessarily constant over the expected service life of an HDD. Elsewhere he implies that Seagate’s use of the first-year AFR is improper. Historically the shape parameter for the Weibull life distribution has been less than 1 for HDDs, meaning that *the first year AFR* will be *the highest* of any of the years during the expected service life of the drive. Any advertised or specified AFR value is a maximum failure probability for any year over the warranty period, expected service life, or both. As explained in Section B above, with regard to the Grenada drives, Seagate always projected AFR values based on estimates for Eta and Beta using data from reliability testing on Grenada drives, and in each case, confirmed that the Beta value was less than 1. Hospodor has provided no contrary evidence. So an emphasis on the first year AFR is reasonable since it will be the maximum AFR for the relevant period.

#### **D. Seagate’s Usage Estimates Were Reasonable**

42. Seagate set goals for cumulative failure probabilities out to 5 years as summarized in Figure 3 below which shows a table from their “Best in Class 5 year Service Life Initiative.”<sup>14</sup> (FED\_SEAG0056259, at p. 56262.) This table summarizes design goals for *total* failure rate or probability, (“FR”), over 5 years in different kinds of applications or market segments. The MTBF is the mean time before failure over that period, and does not assume any particular shape of the failure distribution. In other words, one can have the same mean (or average) failure time regardless of whether the failure rate starts higher and decreases with time, starts lower and increases with

several software tools that assist the process, including the Weibull++ and JMP software, with which I am familiar, and which Seagate used.

<sup>14</sup> Hospodor cites this document several times in his Declaration, and even cites this specific page. (See Hospodor Paragraph 33 footnotes 8, and Paragraph 111 and footnote 53.) Yet Hospodor claimed in his deposition that he had never seen the document before and wouldn’t have relied on it because it doesn’t list a single author. [CITE] This further supports my opinion that Hospodor’s characterization and review of the evidence he cites was sloppy at best.

1 time, or stays steady for the entire period. Thus, the FR goal can also be achieved regardless of the  
2 distribution shape. Hospodor does not seem to understand this principle because he repeatedly  
3 implies that the *shape* of the failure rate distribution over time (Beta) determines the value of the  
4 AFR, the number of failures over time, and the cumulative failure probability (the FR). Seagate's  
5 former employee Andrei Khurshudov, on whom Hospodor claims to heavily rely, explained this in  
6 his deposition, yet Hospodor either ignores or seems not to understand it. (See Ex. 14 [Khurshudov  
7 Depo.] at 81:21-82:9, 84:7-86:8.)



18  
19 **Figure 3.**

20  
21  
22  
23 43. The “mission time” column in the table expresses Seagate’s understanding of how  
24 heavily its different products would be used. This can also be expressed in the form of power-on-  
25 ours (“POH”) per year. In paragraph 36, Hospodor incorrectly defines power-on hours, POH, as  
26 “the number of hours a year that the drive is powered on.” It is correctly defined as just the number  
27 of power-on hours accumulated for an HDD at any point in its life. (It is similar to the odometer in  
28 a car.) And it does not indicate the workload when powered-on. The number of POH per year is the



1 key and only assumption that goes into an AFR estimate. The value used must be less than the  
2 number of hours in a year, 8760 ignoring leap years, and depends on the application.

3 44. As shown in Figure 3, for the SBS backup HDD, the POH per year is 730 hours/year  
4 or 3650 hours for the 5 year service life goal. Based on my experience, two hours a day is  
5 reasonable for external, backup, USB products because such products are meant for backup  
6 purposes. It would be difficult to use them for anything else, such as running a computer's  
7 operating system or acting as the primary data store for a computer. For desktop OEM and Disty  
8 HDDs Seagate assumes 2400 POH/year used in typical desktop or home applications.<sup>15</sup> Based on  
9 my experience this is also reasonable, since most desktop computers are used by individuals and  
10 therefore not used 24 hours a day 7 days a week. Furthermore, even when a desktop computer is  
11 running, it does not continuously use the hard drive at maximum workload.

12 **E. Seagate's Drive Development and Manufacturing Process Was Appropriate and**  
13 **Consistent with Industry Standards – Including Release of Drives to SBS before**  
14 **Release to Disty**

15 45. My review of the documents Hospodor cites, Seagate's ISO certifications, and the  
16 declaration and depositions of Seagate employees demonstrates that Seagate's drive development  
17 and manufacturing processes were appropriate and consistent with currently accepted industry  
18 practice and standards. This applies to both Seagate's development and drive qualification or  
19 approval process, and Seagate's post-release, ongoing reliability and quality monitoring. Among  
20 other things Seagate's drive design and manufacturing processes have been ISO-certified since  
21 1993.<sup>16</sup> (Paneno Decl., ¶ 4.) The ISO 9001 certifications included examining Seagate's product  
22 development process, reliability testing, quality controls, supplier controls, and ship holds process.  
23 (Paneno Decl., ¶ 3.) Hospodor does not present any evidence that Seagate's processes were  
24 insufficient or flawed.

25 46. Seagate's Product Life Cycle Process is consistent with my experience since the early  
26 1990s and currently accepted industry practice in the computer and HDD business.

27 <sup>15</sup> Moreover, Seagate also included the 2400 POH/year specification in product Data Sheets  
28 that mention the <1% AFR rating. (See Paragraph 53.)

<sup>16</sup> Copies of ISO certificates indicating certification since 1996 (for its Longmont, CO  
facility) and 1999 (for other sites) to present are available on Seagate's website at  
<https://www.seagate.com/global-citizenship/iso-9001-certification/>. (Paneno Decl., ¶ 4.)

1 (FED\_SEAG0027285) The process used by Seagate is consistent with the state of the art among  
2 hard drive producers.

3 47. Hospodor describes in Paragraph 42 the fact that Seagate first released a new drive to  
4 the “internal” SBS customer before later qualifying the drive for release to the Disty and OEM  
5 channels. SBS (Seagate Branded Solutions) was Seagate’s division that used the drives within  
6 external, USB products. The practice of releasing drives to internal customers first is customary in  
7 the industry and there are several reasons for it. First, the SBS teams need to complete development  
8 and qualification of the SBS products, which include not only the HDD, but a mechanical enclosure,  
9 additional electronics, software and retail packaging, and usually a power supply. All of these  
10 components need to be tested and developed with the drive, so the SBS teams need to receive drives  
11 ahead of the time that they will eventually release in the integrated products. Second, for SBS  
12 (external, USB) products, the end application of the HDD is defined—the HDDs are being put into  
13 external, USB products that Seagate builds—so that drive environment and the usage patterns of the  
14 products are well understood. The POH per year and workloads are known to be low, which  
15 requires less accumulated reliability test time to estimate an MTBF that is consistent with offered  
16 warranties and customer expectations. As explained above, the evidence I have seen shows that  
17 Seagate did not advertise an AFR for external, USB products containing the Grenada drives.  
18 Rather, Seagate required the SBS drives to meet an MTBF of 100,000 hours, which is reasonable.  
19 (*See* Dewey Decl., ¶ 11; Almgren Decl., ¶ 12; FED\_SEAG0026697 at 26699; FED\_SEAG0026867  
20 at 26870 and 26886.)) Seagate’s process for testing and qualifying SBS products meet currently  
21 accepted industry practice in this regard. By contrast, the end environments are not as well known  
22 for OEM and distribution markets. In other words, for the disty market, individual users are  
23 inserting the drives into their own desktop computers or systems, and Seagate does not control that  
24 end-use environment. Similarly, OEMs can have varied requirements and enclosures/systems. The  
25 expected POH per year and workloads are higher for disty/OEM (internal, desktop) drives. So more  
26 accumulated reliability test time is needed to make AFR predictions for them. Therefore, drives are  
27 typically released for use as internal, desktop drives later than they are released to internal  
28 customers/SBS product uses.

48. Finally, after drives were approved for release and put into production, Seagate monitored the quality and reliability parameters for the drives that were coming off Seagate's production lines, using ongoing reliability testing (ORT). Seagate's ORT used the same high-stress workload and temperatures protocols as Seagate's pre-release, RDT described above, except that Seagate employed ORT on a rolling population of drives sampled from the end of the manufacturing line. (Netel Decl., ¶¶ 9-19.) If the results of ORT testing exceeded any of Seagate's trigger limits, Seagate issued a ship hold or stop ship order (SSO) and stopped shipment of drives until Seagate had demonstrated that it had corrected the problem. (*Ibid.*; *see also*, e.g., Ex. 9 [FED\_SEAG0009670] (reporting a ship hold issued for ORT trigger).)

49. These practices are fully consistent with current, accepted industry norms. Moreover, Seagate has been ISO 9001 certified since well before the development of the Grenada drives, providing further evidence that Seagate's manufacturing and quality control processes meet industry standards.

**V. Hospodor's Claims about the "Advertised" AFR of the Drives Are Not Supported (Hospodor's Section IV.E)**

50. It is my opinion that an expert is not required to understand or interpret Seagate's website or Seagate's marketing materials, user guides, data sheets or other publications for consumers regarding the Grenada drive products. It is my understanding this is Hospodor's position as well. (Ex. 11 [Hospodor Depo.] at 315:22-317:13 ("I think that any person could look at Seagate's website and see what it says about AFR."; "I think that the product manuals and the data sheets are written to be as simplistic as possible . . . . So I would say no, they don't require a Ph.D. in computer engineering to understand them.") However, because Hospodor draws so many conclusions that depend on his assertions regarding Seagate's consumer-facing publications, I believe it is appropriate to point out that his assertions are incorrect based on the information available to me.

51. The evidence I have reviewed does not support Hospodor's assertion that Seagate "advertised" an AFR of 0.34% in April, 2011 when Seagate "first released" Grenada Classic drive for shipment as part of the SBS product. Hospodor cites one document that Seagate's employee



1 Karl Schweiss testifies is a draft document that was never published to consumers. (Schweiss Decl.,  
2 ¶¶ 6-7.)

3 52. The evidence I have reviewed also shows that Seagate did not publish or advertise an  
4 AFR specification for the SBS (external, USB) products. (*See* Dewey Decl., ¶ 17; Almgren Decl., ¶¶  
5 12, 21; Schweiss Decl., ¶ 14; Fochtman Decl., ¶¶ 7-8; Payne Decl., ¶ 14.)

6 53. The evidence I have seen indicates that Seagate, at some times, published an AFR of  
7 <1% for internal, desktop products only (e.g., the Barracuda product and Internal HDD product).  
8 (*E.g.*, Schweiss Decl., ¶¶ 10-14; Fochtman Decl., ¶¶ 9-10; Berman Decl., Exs. 2, 3, 11, 12, 14-19.)  
9 However, the data sheets I have seen show that Seagate also specified that the <1% AFR was for  
10 2,400 POH per year. (Payne Decl., ¶ 12.) By contrast, the documents in which Seagate mentioned  
11 an 8760 POH/year number did not contain any AFR number.<sup>17</sup> (*Id.*)

12 **VI. Hospodor Fails to Support His Claims that the ST3000DM001 Drives Had a “Higher**  
13 **than Advertised” AFR**

14 54. In his Sections IV.F. and IV.G (paragraphs 59-89) of his declaration, Hospodor  
15 presents evidence he claims shows that “the Drives” had a “higher than advertised” AFR.  
16 Hospodor's opinions are based entirely on analyzing documents written and produced by Seagate.  
17 Hospodor does not claim to have performed any testing or analysis of ST3000DM001 drives, or  
18 attempted to independently determine the failure rate of any of the drives. (See e.g., Hospodor  
19 Decl., Appendix 1 (materials on which Hospodor relied); Ex. 11 [Hospodor Depo.] at 50:4-22,  
20 54:17-55:5.) Hospodor's opinions rest on misinterpreting or misrepresenting Seagate's documents,  
21 and are not supported by the evidence he cites.

22 **A. The Majority of Hospodor’s Analysis Relates to SBS Products**

23 55. The bulk of Hospodor’s analysis—including all of Paragraphs 61 to 79—relates  
24 solely to Seagate’s testing and qualification of the Grenada Classic drives for use in a single

25 <sup>17</sup> Furthermore, it is my understanding that Plaintiffs’ evidence shows that at most, Seagate  
26 published a “0.34%” AFR for the ST3000DM001 drives for approximately 4 months at the end of  
27 2013. (Hospodor Decl., ¶ 54 (claiming that the 0.34% specification was published from September  
28 2013 to January 2014). *See also* Fochtman Decl., ¶¶ 9-10 (explaining that when Seagate published  
the “0.34%, <1%” AFR Hospodor cites, it was clearly combined information for many different  
drives, and did not state that the 0.34% AFR applied to the ST3000DM001 drives); Payne Decl., ¶  
12 (at the time Hospodor claimed Seagate published the “0.34%, <1%” AFR, the Data Sheets at  
those times specified that the ST3000DM001 drive had a “<1%” AFR for 2400 POH.))

external, USB (SBS) product. All of these paragraphs analyze a single document, the “Grenada SBS SAD” dated 4/28/2011. (Ex. 1 [FED\_SEAG0026697].) This was the approval to ship the Grenada *Classic* drive *as part of a single SBS (external, USB) product, codenamed “Rockit.”* (See Dewey Decl., ¶ 10; Ex. 1 [FED\_SEAG0026697] at 26699.) Hospodor claims this document shows “Seagate knew that it was falsely advertising the failure rate of the Drive.” This cannot be true because Seagate did not publish an AFR for the SBS products. (Section V.) Accordingly, Hospodor’s extensive discussion of the Grenada SBS SAD does not support his conclusion that the AFR of the drives was “higher than advertised.”

56. Seagate required SBS products to have an MTBF of 100,000 hours, and Seagate demonstrated the Grenada Classic drives met this requirement at the time they were approved for this SBS release. (Ex. 1 [FED\_SEAG0026697] at 26699, 26703, 26705; Dewey Decl., ¶ 11; Almgren Decl., ¶ 12.) Even so, a demonstrated 100,000 hour MTBF could reasonably result in a projected AFR <1% for external, USB products like these. Specifically, as explained above, these products were expected to have fairly low usage. Seagate estimated 2 hours/day, which is reasonable for external, USB products like these. Even assuming a power on hours of 1000 hours/year (2.7 hours/day), for an MTBF of 100,000 hours this results in an AFR <1%.

57. In the remainder of Paragraphs 61-79, Hospodor continues to analyze the SBS SAD for the Grenada Classic drives, and draws numerous unfounded conclusions from it. I will discuss some of Hospodor’s additional claims about this document further below. (See Section IX.)

58. In Paragraph 83 Hospodor cites to the *SBS* ship approval document for the Grenada *BP* drives. (Ex. 3 [FED\_SEAG0026867].) Hospodor claims this document shows “testing conducted on April 12, 2012 revealed a first-year AFR of 2.942% and a ‘demonstrated reduced AFR’ of 2.0%.” However, this was the approval for shipping the Grenada BP *as part of external, USB (SBS) products.* (Dewey Decl., ¶ 17.) Since Seagate did not publish an AFR for external, USB products this document cannot support Hospodor’s claim that the AFR was “higher than advertised.” As noted, for use in SBS products, Seagate required the drives to show an MTBF of 100,000 hours. In this case, Seagate tested 1068 drives for an average of 661 hours and demonstrated an MTBF of 118,000 hours. (Ex. 3 [FED\_SEAG0026867] at 26887.) Once again,



Seagate clearly utilized MLE on the actual failure data from this testing to estimate the Weibull parameters (including Beta) and to calculate the projected MTBF (and AFR). Since Seagate did not publish an AFR for these products, Hospodor's claim that "the 'potential reduced AFR' was also well in excess of the advertised failure rate" is unfounded.

**B. Hospodor's Claims Regarding Grenada Drives Used in Internal (Disty) Products Are Not Supported by the Document He Cites**

59. Beginning in paragraph 80 through 81 Hospodor refers to the test results table for reliability testing and analysis in the "Grenada SAD Approval 10/18/11" which was the approval to ship the Grenada Classic drives as internal, desktop drives (the OEM and Disty products). (Ex. 2 [FED\_SEAG0026839].) *This document shows that the drives had a "Demo'd Reduced AFR" (demonstrated reduced AFR) of 0.95%* at the time they were approved for sale as internal drives. "Demo'd Reduced AFR" meant that Seagate had *demonstrated* the efficacy of listed corrective actions, which reduced the AFR of the drives to the value stated in the "demo'd reduced" number. In other words, the demonstrated reduced AFR is the relevant AFR value because it reflects the demonstrated results of changes in place at the time the drives were approved.<sup>18</sup> (Almgren Decl., ¶ 18; Ex. 13 [Almgren Depo.] at 143:20-145:5, 162:2-18; Dewey Decl., ¶ 15.) The raw AFR Hospodor cites (2.621%) is **not** the AFR for drives shipped to customers because it does not reflect changes Seagate had already made (and demonstrated were effective at reducing the AFR). Furthermore the Demo'd reduced AFR of 0.95% met Seagate's internal requirements and comported with the published AFR of 1%. The document makes clear that this projected AFR was calculated using MLE on the results of testing 1,360 drives for an average of 953 hours.

60. In Paragraph 81, he goes on to incorrectly claim that "Seagate's own internal testing of the Drive revealed an increasing, not decreasing, AFR. AFR typically increases when drives begin to wear out as they approach the end of their design life. Early wear out is a hallmark of unreliable products, and are often due to flaws in the design or components." None of these statements make sense. The actual relevant sequence of demonstrated AFR projections at this time

<sup>18</sup> It is customary to revise AFR predictions in the course of development as root-cause for test failures are found and corrective action confirmed. Seagate conservatively called this the 'Demo'd Reduced AFR.' It is standard practice that all corrective action listed must be in place to start volume production thereafter.



1 was 2.34% at SBS SAD on 4/28/2011 (with 740 hours on average per unit) and 0.95% at  
 2 Disty/OEM SAD on 10/18/2017 (with 953 hours). This is *not* an “increasing” AFR. (*See also*  
 3 Figure 2 *supra*. (the raw AFR also decreased).) Furthermore, in both cases, the estimated Weibull  
 4 Beta or shape value was less than 1. In fact it was 0.63955018 for the Disty/OEM SAD. This means  
 5 that the projected first year AFR would be the highest for any year during the service life, and would  
 6 decrease in subsequent years of use. Any claims that the AFR was ‘increasing’ are completely  
 7 unsupported. Furthermore, Hospodor’s statements about “wear out” are incoherent and jumble  
 8 meaningless statements about “wear out” at the end of a product’s design life, with its opposite,  
 9 “early wear out.” (*See also* Almgren Decl., ¶ 18.)

10 61. In Footnote 38 Hospodor references the “Grenada BP ECQ Approved Final” on  
 11 5/5/2012 (30). (Ex. 4 [FED\_SEAG0026751].) This document approved the general release of the  
 12 Grenada **BP** drives as internal (Disty) drives. Hospodor claims this document shows that the AFR  
 13 for “the Drive” “remained” higher “than advertised.”<sup>19</sup> This is not the case. This document shows  
 14 that the relevant AFR (the ‘Demo’d Reduced AFR’) of the Grenada BP drive was 0.98%, based on  
 15 testing 1068 drives for an average test time of 1009 hours. (Dewey Decl., ¶ 18; Almgren Decl., ¶  
 16 22.) This comports with released and published documentation for internal, desktop products (the  
 17 Barracuda and Desktop HDD products) and it met Seagate’s internal requirements. As with other  
 18 AFRs, Seagate clearly utilized MLE on the actual failure data to estimate the Weibull parameters  
 19 (including Beta) and to calculate the projected MTBF (and AFR). Importantly, the first year AFR  
 20 was not 2.917% as Hospodor claims. Hospodor quotes the raw AFR, before the changes Seagate  
 21 made to achieve the demonstrated reduced AFR. As explained, the raw AFR does not represent  
 22 drives shipped to consumers, because it does not include the changes Seagate implemented.

23 62. Finally, Exhibit 5 [FED\_SEAG0057277] contains the approval for general release of  
 24 the Grenada **BP2** drives to SBS and Disty/OEM on January 15, 2014. This document shows that the

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26 <sup>19</sup> In addition, *the Grenada BP was a new version of the ST3000DM001 drive with*  
 27 *significant changes*. (Dewey Decl., ¶ 6; Ex. 11 [Hospodor Depo.] at 191:23-192:18.) Thus, it was  
 28 required to go through new RDT testing before being approved for release. In other words, the  
 document containing the approval for the initial release of the Grenada BP drive as an internal  
 (Disty) drive, concerns a new release, not post-release testing on a previously released drive as  
 Hospodor implies.

1 relevant AFR (the ‘Demo’d Reduced AFR’) of the Grenada BP2 drive was 0.9%, based on testing  
 2 1058 drives for an average test time of 1197 hours. (Almgren Decl., ¶ 29 and fn. 5; Ex. 5  
 3 [FED\_SEAG0057277] at 57324; *See also* Paragraph 78 below.)

4 **C. Only Two Documents Contain AFRs above 1% for Internal (Disty) Drives, but**  
 5 **the Drives at Issue Did Not Reach Consumers**

6 63. Hospodor cites only two documents containing AFRs over 1% for internal (Disty)  
 7 drives. Both relate to Grenada *Classic* drives *in 2012* that were not being shipped to consumers at  
 8 the time. Hospodor cites no evidence that Grenada BP or Grenada BP2 drives had AFRs over 1%.  
 9 First, in Paragraphs 84 and 85, Hospodor references the Ongoing Reliability Testing (“ORT”) for  
 10 Grenada *Classic* drives *in June 2012*. At this time, the Demo’d AFR projection is 2.35%, which is  
 11 above the 1% target for this test and the Classic drive vintage.

12 64. However, the single most important factor to consider is that the Grenada Classic was  
 13 under a ship hold at the time, *so the drives in question were not being shipped to consumers*.  
 14 (Netel Decl., ¶21.) Hospodor himself cites a document demonstrating that the Grenada Classic  
 15 drives were under a ship hold at this time. (Ex. 7 [FED\_SEAG0008927 reproduced as  
 16 FED\_SEAG0054950].) Hospodor does not cite any evidence that internal (Disty) drives referenced  
 17 in this document were shipped to consumers. Furthermore even though this Grenada Classic ORT  
 18 estimate is high, it is not excessive or indicating some sort of epidemic. The Demo’d Reduced  
 19 failure rate of 2.35% is certainly not “ten times” higher than the published AFR of 1%.

20 65. Hospodor cites only one other document as containing an AFR above 1% for internal  
 21 (Disty) drives. In his Paragraph 177 and Figure 26, Hospodor cites Exhibit 9 [FED\_SEAG0009670]  
 22 as showing an AFR above 1% for the Grenada *Classic* drives for a few weeks in *early 2012*. (The  
 23 document is dated February 7, 2012.) However this document reports that Seagate issued a ship  
 24 hold on the drives because they were over the 1% AFR trigger. Seagate was not shipping these  
 25 drives to consumers either. **Hospodor does not present any evidence that internal Grenada**  
 26 **drives with AFRs above 1% were ever shipped to consumers**, much less that any such practice  
 27 existed across different products or over time.

28 66. Furthermore, the AFR numbers reported in the two documents cited above “raw,”

pre-fix numbers and for this reason as well, do not show the AFR of drives actually being shipped to consumers.<sup>20</sup> (Netel Decl., ¶¶ 21, 30-33, 38.)

**VII. Hospodor's Opinion that "Seagate's Reliability Testing Underestimated the True AFR of the Drive" Is Not Based on Sufficient Evidence nor Accepted Principles of Reliability Analysis**

67. In his Section IV.H, Hospodor asserts that Seagate's "reliability testing" and analysis was flawed because Seagate "used" or "assumed" a Weibull Beta value of less than 1—which "underestimated" the AFR of the drives—and instead, Seagate should have used a Weibull Beta value of  $> 1$  to estimate AFRs for the Grenada drives. Hospodor's conclusions are based on misunderstandings or misrepresentations of Seagate's calculations of AFR, and accepted principles of reliability analysis, Weibull analysis and the Weibull parameters Beta and Eta. In particular, (a) Hospodor's opinion is based on the incorrect assumption that Seagate 'assumed' a Beta value, when in fact, Seagate always derived Beta from actual test data; (b) Hospodor's opinion makes no sense because using a Beta  $> 1$ , as Hospodor insists Seagate should have done, would have given even lower AFR values; (c) Hospodor cites only three items of 'evidence' to support his conclusion, but his reliance on them is seriously flawed.

**A. Seagate Did Not 'Assume,' 'Select' or Use a Pre-Selected Beta Value of  $< 1$**

68. As explained above, the documents Hospodor cites clearly indicate that Seagate did not assume, select, or use a pre-selected Beta value, but instead, in every case, Seagate used maximum likelihood estimation to estimate the Weibull parameters Beta and Eta from actual test data on a specific group of drives. (Section IV.B, *supra*.) These facts were confirmed by Seagate's witnesses in deposition and in their declarations. (*Id.*)

69. Seagate used an appropriate, widely-accepted and widely-used methodology for determining Beta—MLE on actual test data. In each case, Beta was less than 1. (See Figure 2, above.) Hospodor claims that rather than using this method, Seagate should have ignored the Beta

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<sup>20</sup> Finally, the combined low average number of test hours (535 hours or 3 weeks rather than the full 6 weeks) could contribute to 'noisy' or even elevated results. Specifically, if drives exhibit "infant mortality" or early failures, then the drives will appear to have a high AFR early in testing, but as testing goes on, the drives that didn't fail will accumulate more time in testing and this will bring down the AFR. So a population of drives assessed at 535 hours (as these drives were) may exhibit a higher AFR than the same drives assessed after a full 1008 hours of testing.



1 values that were based on the actual test data, and selected some other, unspecified value “greater  
 2 than 1.” (e.g., Hospodor Decl., ¶ 95.) Hospodor does not explain what value Seagate should have  
 3 used, or what method Seagate should have employed to select a different Beta value. Hospodor  
 4 provides no evidence or information to show that his suggested methodology—ignoring the actual  
 5 test data and simply ‘selecting’ some other Beta value—is accepted or used in the industry or  
 6 anywhere else. In other words, Hospodor provides nothing to show that his opinion is based on  
 7 accepted or sound principles or methods of reliability analysis. It is not. It is completely baseless.

#### 8 **B. Hospodor’s Opinion Makes No Sense**

9 70. Hospodor’s opinion is also fundamentally flawed because using or assuming a Beta  
 10  $<1$  is actually pessimistic and conservative, and will give a higher predicted AFR (especially if the  
 11 ‘true’ Beta is  $\geq 1$ ) compared to using a Beta of 1 or greater than 1. (See Paragraph 20 and Figure 1  
 12 above.) In other words, if Seagate had done as Hospodor insists it should have done, and “used” a  
 13 Beta greater than 1, Seagate would have calculated AFRs that were even lower than the AFRs  
 14 reported in Seagate’s documents! Hospodor’s claim that Seagate “should have used” a Beta  $> 1$   
 15 makes no sense.

#### 16 **C. Hospodor’s Three Pieces of Evidence Do Not Support His Opinion**

##### 17 **1. The Sequence of “Increasing” AFRs**

18 71. In the last sentences in paragraph 85, Hospodor claims, “Seagate’s AFR went from  
 19 2.34% to 2.621% and up to 3.436% within eight months after the start of mass production. This is a  
 20 strong indication that the Drives were wearing out prematurely.” In paragraph 90 Hospodor repeats  
 21 the sequence from paragraph 85 (with some typos) saying “failure rate actually increased from an  
 22 AFR of 2/34% to 2.61% to 3.436%”. In Paragraphs 94 Hospodor claims that a Beta value of less  
 23 than 1 “represents an assumption that the Drive will have a declining failure rate over time.” And in  
 24 paragraph 95, Hospodor again claims that he AFR for the Grenada Classic drive “increased” over  
 25 time “from 2.34% to 2.621% to 3.436%.” He claims this indicates “Seagate’s testing was flawed,”  
 26 and that Seagate “should have used a  $\beta$  value greater than 1, rather than 0.608098.”

27 72. Hospodor misrepresents the sequence and his logic is clearly flawed. As noted,  
 28 Seagate did not assume a Beta value but instead estimated by MLE using reliability test data.

1 Second, Hospodor mis-matches different AFRs to create the impression of a steadily increasing  
 2 AFR. All of these values are taken from results of testing Grenada Classic drives, but Hospodor did  
 3 not consistently use the same type of AFR estimate. Specifically, the first number is the *Demo'd*  
 4 *Reduced* AFR and the next two are the *raw* AFRs. (See Figure 2 above.) Furthermore, the first and  
 5 last values are taken early in the tests when average test time is significantly less than 1000 hours  
 6 such that AFR estimates can be systematically higher. It is clear that Hospodor mixed and matched  
 7 the different estimates to create the impression that AFRs were “increasing.” The sequence of  
 8 Demo'd AFR estimates was actually 2.34%, 0.95%, and 2.35%—which is not an increasing  
 9 sequence and does not support Hospodor's conclusions. Similarly, and although the raw AFRs do  
 10 not represent the AFRs of drives shipped to consumers, the sequence of raw AFRs is 7.006%,  
 11 2.621%, 3.436%—also not an increasing sequence.

12 73. Moreover, Hospodor's entire analysis of the sequence of test results is based on a  
 13 fundamental (and glaring) misunderstanding of reliability analysis and the Weibull distribution.  
 14 Hospodor cites a sequence of projected AFRs from accelerated testing on *three different*  
 15 *populations of drives all starting at 0 hours of testing* and all ending at 1,000 hours or less of test  
 16 time. (Almgren Decl., ¶ 23.) This sequence *cannot be used to determine whether Beta is greater*  
 17 *than or less than 1*. As explained above, the Beta parameter describes whether the failure rate is  
 18 *increasing or decreasing with greater amounts of “age,” i.e., time that the products are used or*  
 19 *tested*. As explained, it is the equivalent of examining whether the rate of deaths increases or  
 20 decreases *as a population ages*. Hospodor lists the AFRs from three different drive populations  
 21 manufactured at different times, but all tested to roughly the same “age” (less than 1000 hours). He  
 22 claims that because the AFRs were (allegedly) increasing across the three groups, this means that  
 23 Beta was >1 and the failure rate was increasing *with time in use (age of the drives)*. This is the  
 24 equivalent of looking at the probability of dying *at age 10* in 1700, 1800 and 1900, and claiming  
 25 that if this *annual* death rate went up between 1700 and 1900, this means that human *death rates*  
 26 *increase with age*—e.g. that 40 year-olds have a higher chance of dying than 10 year-olds. This  
 27 conclusion does not follow from the data. The probability of dying *as a 10 year-old* (the AFR) in  
 28 1700 vs. 1900, does not tell you whether 10 year-olds have a higher or lower chance of dying *than*

1 **40 year-olds**. Similarly, the AFR for drives manufactured in 2011 vs. those manufactured in 2012,  
 2 does not tell you whether drives used for 6 months have a higher or lower chance of failing  
 3 *compared to drives used for 2 years*. That Hospodor thinks that his sequence of three AFRs (from  
 4 three different test populations of drives all tested to the same age) can be used to determine whether  
 5 Beta was greater than 1 further demonstrates Hospodor's fundamental misunderstanding of accepted  
 6 reliability analysis methodologies (in particular, the Weibull distribution and the significance of the  
 7 Beta parameter). It is simply not possible to use the sequence of AFRs Hospodor cites to reach his  
 8 stated conclusion that Beta was greater than 1 or that the drives were 'wearing out prematurely.'

9 74. Hospodor goes on to say in Paragraph 91 that Beta or the shape parameter is the more  
 10 important of the two primary parameters in the Weibull distribution. This is not correct, as  
 11 explained in Paragraph 37 above.

## 12 2. Hospodor's Reliance on Khurshudov Is Misplaced

13 75. Beginning in paragraph 96 through 111, Hospodor introduces and discusses former  
 14 Seagate employee Andrei Khurshudov's ("Khurshudov's") report on "Product Failure Rate Trends  
 15 and the Role of Workload Stress" from about June of 2012 at which time he worked for Seagate.  
 16 First, Hospodor simply ignores the fact that the Khurshudov report's conclusions do not apply to  
 17 consumer, desktop drives like Grenada. In fact, in his deposition, Khurshudov explained that for  
 18 desktop drives used in consumer applications (like Grenada), *his report showed that those drives*  
 19 *always behaved as expected, with Beta less than 1*. (Ex. 14 [Khurshudov Depo.] 126:23-129:10  
 20 ("The thing is for the -- this client space, *for desktops and mobile drives*, this -- *this study actually*  
 21 *didn't show any even hints of wearout. The beta is always below 1*. So the conclusion would be --  
 22 and this is again part of this study -- *it's a low workload environment, and drives behave exactly*  
 23 *how we expect*. It's our mission critical products that might be affected.") Hospodor simply ignores  
 24 what Khurshudov said about the conclusions of his own report, and then misapplies the report—to  
 25 reach the opposite conclusion from what the report actually showed (which was Beta was less than 1  
 26 on consumer, desktop drives).

27 76. Second, there are several flaws in the report that Hospodor incorrectly endorses.  
 28 These are:

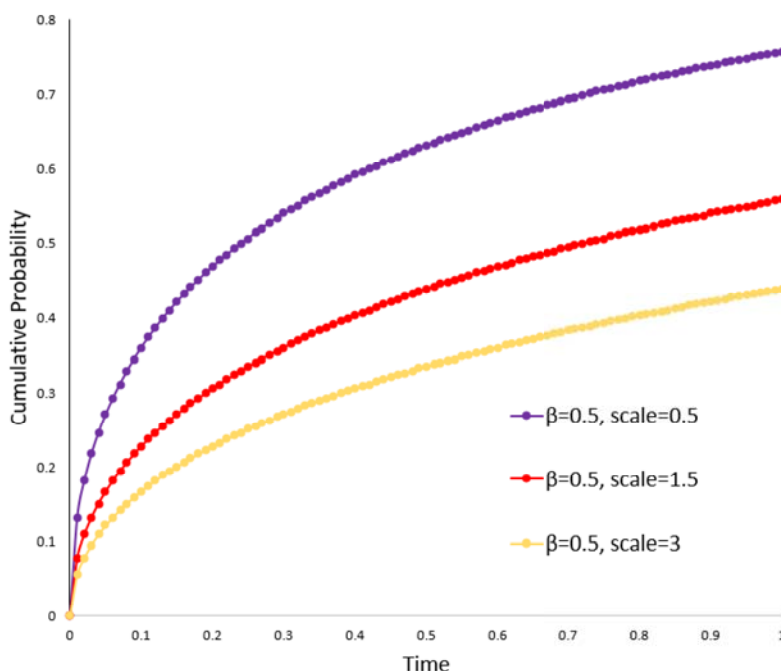


1           a.       Hospodor endorses the statement shown in the slide in his Figure 11 that wear  
2 out phenomenon (where  $\text{Beta} > 1$ ) is highly undesirable. This idea is naive. “Wear out” is  
3 unavoidable; everything eventually wears out (or dies). The key to a successful product is  
4 that its characteristic life is long enough to meet service life expectations.

5           b.       The data is based on returns, not failures. Returns include failures and non-  
6 failures, and non-failures can be a large fraction of the total. For example, another document  
7 by Khurshudov shows that over 75% of returned products can have no trouble found, and a  
8 large proportion may never have even been used. (Ex. 15 [FED\_SEAG0002320] at 2327;  
9 Almgren Decl., ¶ 25; Ex. 14 [Khurshudov Depo.] at 36:25-39:14.) Furthermore some  
10 failures may not be returned. Drawing conclusions about failure rates from return rates is  
11 unreliable.

12           c.       In Paragraph 100 Hospodor refers to the plot taken from Khurshudov’s report  
13 shown in Figure 12 of his declaration. (See Hospodor Decl., ¶¶ 101 and Figure 12.) Both  
14 Hospodor and Khurshudov incorrectly conclude that the curves are “exhibiting failures rates  
15 consistent with  $\beta$  increasing to and possibly surpassing a value of 1.” First, Khurshudov  
16 testified that he drew his conclusions by simply ‘eyeballing’ the graph in question, and  
17 drawing some lines, but did not do any mathematical analysis of the data. (Ex. 14  
18 [Khurshudov Depo.] at 88:17-90:1, 95:7-96:18, 96:23-97:23, 99:1-9.) Hospodor  
19 acknowledged in his deposition, that visual examination of graphs like Figure 12 cannot be  
20 used to make conclusions about Beta. (Ex. 11 [Hospodor Depo.], 88:10-96:10.) However,  
21 this is exactly what Khurshudov did, and Hospodor adopts Khurshudov’s unfounded,  
22 ‘eyeball’ opinions even though he acknowledges that Khurshudov’s approach is unsound.<sup>21</sup>  
23 (*Ibid.*) Moreover, all of the curves in this plot are consistent with  $\text{Beta} < 1$ . In fact, *the*  
24 *graph at issue shows that Beta and/or the characteristic life (scale parameter Eta) are*  
25 *decreasing for the cumulative return data plotted.* For example, Figure 4 below shows a  
26 constant Beta and a *decreasing Eta*.

27           <sup>21</sup> Even Khurshudov noted on the slide at issue that more complete data analysis is needed  
28 to confirm his observation, yet Hospodor accepted the observation (which is methodologically  
unsound) without any further data analysis.



**Figure 4.** Shape parameter ( $\beta$ ) held constant at 0.5; scale parameter ( $\eta$ ) decreasing from 3 (gold line) to 1.5 (red line) and 0.5 (purple line). (Figure prepared using Excel and Excel's Weibull function.)

d. After adopting Khurshudov's incorrect 'eyeball' claim that Beta showed a "progression" from  $\beta < 1$  to  $\beta > 1$ , Hospodor goes on to claim that "the data points of *the Grenada fall in the  $\beta > 1$  range.*" (See Hospodor Decl., ¶¶ 101.) Hospodor makes a conclusion about "the Grenada" drives even though Khurshudov refused to draw any such conclusion because there simply was not enough data about Grenada. (See Hospodor Figure 12 ("We should wait until we could make a conclusion about Grenada"); Ex. 14 [Khurshudov Depo.] at 99:25-101:10.) Moreover, as noted, Khurshudov explained that his report showed for consumer drives Beta was always less than 1 and the and the conclusions about Beta greater than 1 and wear out did not apply to desktop drives like Grenada. (Ex. 14 [Khurshudov Depo.] 126:23-129:10.) Hospodor's attempt to stretch Khurshudov's statements to cover Grenada drives lacks any reasonable basis and is not supported by the data.

e. Both Hospodor and Khurshudov repeatedly say that Weibull Beta or shape

1 values are ‘assumed.’ As previously discussed, this is simply not the case. (See Section  
 2 IV.B.) It appears that Khurshudov was not involved in Seagate’s actual reliability testing or  
 3 calculations of AFRs, so this may explain why he made misstatements about how Seagate  
 4 actually determined Beta and AFR.<sup>22</sup> (See Ex. 14 [Khurshudov Depo.] at 13:24-15:11;  
 5 24:16-25:16.; Almgren Decl., ¶ 24.) At any rate, Khurshudov explained in his deposition  
 6 that Beta and AFR are based on fitting the Weibull distribution to actual test data (Ex. 14  
 7 [Khurshudov Depo.] 47:13-49:5.)

8 f. The emphasis both Hospodor and Khurshudov place on the Weibull shape  
 9 parameter, Beta, while excluding the characteristic life, Eta, is not correct. At least two  
 10 parameters are need to make a useful AFR projection, and the Eta parameter is just as  
 11 important as Beta.

12 77. In Paragraphs 106 to 108 of his declaration, Hospodor references a suggestion by  
 13 Khurshudov that “Longer-term reliability tests (~1 Year) might need to be introduced to gain more  
 14 confidence in reliability projections.” ***But Khurshudov testified that this conclusion did not apply***  
 15 ***to desktop or consumer drives like Grenada***—it only applied to high-workload, enterprise drives  
 16 (Ex. 14 [Khurshudov Depo.] 126:23-129:10.) Furthermore, it is true that confidence in the  
 17 projections can be improved this way and more knowledge of eventual wear out behavior and  
 18 mechanisms can be gained. It is also true that increasing the number of test samples will improve  
 19 confidence in the projections. However, there is no reason to think this was necessary to adequately  
 20 test the Grenada drives and Hospodor provides no basis for so thinking. Certainly Khurshudov  
 21 made no such conclusion. (*Id.*; see also Almgren Decl., ¶ 26.) Hospodor offers no basis for  
 22 extending Khurshudov’s suggestion to consumer, desktop drives like Grenada, and I see none. First,  
 23 for HDDs designed for enterprise use (data center applications, servers, cloud computing, etc.) both  
 24 the number of samples and test time is increased in my experience. By contrast, Seagate’s RDT and  
 25

26 <sup>22</sup> The only role in which Khurshudov was involved with reliability was a research role from  
 27 2006 to May 2008, and that role did not involve analyzing reliability of any specific products.  
 28 (*Ibid.*) At the time he wrote the report in question he was “senior director, cloud research and  
 analytics” but Glen Almgren reports that—consistent with his title at the time—Khurshudov was not  
 directly involved in RDT or product qualification and would not necessarily have known how  
 Seagate determined Beta and AFR in those contexts. (Almgren Depo., ¶ 24.)



ORT reliability testing protocol for the Grenada drives—1000 HDDs for 1000 hours—has been widely accepted in the industry for drives like the Grenada drives that are intended for desktop computer applications.<sup>23</sup> Even Hospodor acknowledges that test protocols can be shorter than what Seagate used (30 days rather than 6 weeks). (Hospodor Decl., ¶ 34.) Furthermore, as explained, because Seagate tested the drives at maximum workload (and high temperature) for 6 weeks, Seagate subjected the drives to the equivalent of over 3 to 3.8 years of use and wear. This is more than sufficient to obtain data to project reliability characteristics of the drives over the expected useful life of the drives with reasonable accuracy. Other than his wholly incorrect application of the Weibull analysis (Paragraphs 41, 70-76), and his misplaced reliance on, and misapplication of, Khurshudov’s incorrect conclusions (Paragraphs 75, 76), *Hospodor provides no basis for asserting that Seagate’s testing of the Grenada drives was insufficient*. Therefore, Hospodor’s claims that Seagate’s reliability testing was inadequate and that AFR projections were overly optimistic is not supported by his alleged evidence or arguments. Nonetheless Seagate also tested drives for extended periods of time (an additional 3-6 weeks after the normal 6-week test) to confirm that Beta remained below 1, which it did. (Almgren Decl., ¶ 28; Ex. 13 [Almgren Depo.], at 88:5-90:6.)

### 3. The Grenada BP2 Test Results

78. In paragraphs 112 to 117 Hospodor misinterprets the GrenadaBP2 reliability test results shown in Figure 14 of his Declaration. He incorrectly states “the AFR increased from 1.039% in the first year to 1.951% in the fifth year.” The values for the second year (2Yr FR) through fifth year (5Yr FR) are *cumulative failure probabilities (FR)* projected by the Weibull CDF using estimated parameters based on the test data. They are consistent with an estimated shape factor, Beta, less than 1. Therefore his conclusions are mistaken.<sup>24</sup> Moreover, this document shows

<sup>23</sup> This test design is a good balance between cost of samples and equipment and schedule. For no failures during the test this demonstrates reliability of 0.998 with 90% confidence using the Binomial distribution. The annualized failure rate (AFR) for a product operated this much in one year would be less than 1%.

<sup>24</sup> That the 2Yr FR to 5Yr FR are cumulative and not “annual” would seem obvious given that the first year value is “AFR” (the “annualized” failure rate), but the subsequent numbers are not labeled “AFR” and instead are labeled “FR.” In addition, the only way to arrive at any of these values is to use the Beta and Eta parameters to model the data and derive the AFR and FRs. The AFRs and FRs can’t be “inconsistent” with the listed Beta, because the listed Beta was used to produce the AFR and FRs.

1 that when the Grenada BP2 drives were approved for general release as internal, desktop drives  
 2 (Disty/OEM), the Demo' d first year AFR was 0.90%. Furthermore, the cumulative failure rate  
 3 (probability) at the 5th year was less than 2%--meaning that even after 5 years of use, based on its  
 4 RDT test data, Seagate projected that only 2% total of drives would have failed, while 98% would  
 5 still be operational. This exceeds the goal in the table from the "5-year BIC Service Life Strategic  
 6 Initiative." (See Figure 3 above.)

7 **D. The Backblaze Blog Posts Do Not Support Hospodor's Conclusions**

8 79. In Paragraph 104, Hospodor references Backblaze blog posts and implies that they  
 9 support a conclusion that "the ST3000DM001 ... were not as robust as the competition."<sup>25</sup>  
 10 However, the blog posts do not support this conclusion. It is incorrect to conclude that Backblaze  
 11 compared the Grenada 3TB drives to even a reasonable sample of competitor drives. For example,  
 12 Backblaze did not use or "test" enough Samsung or Toshiba drives to even make a comparison, and  
 13 Backblaze also excluded certain 3TB Western Digital drives from its analysis because they  
 14 performed too *poorly*. (See <https://www.backblaze.com/blog/what-hard-drive-should-i-buy/> ("We  
 15 don't have enough Toshiba or Samsung drives for good statistical results" and later reporting that  
 16 Backblaze excluded Western Digital 3TB Green drives because they failed so quickly.)) In fact,  
 17 Backblaze only used one other brand of 3TB drives in any significant numbers (HGST), while  
 18 excluding 3 brands (Samsung, Toshiba and Western Digital). One cannot conclude that the Seagate  
 19 Grenada 3TB drives were less "robust" than "the competition" when Backblaze only used 1 of 4  
 20 competitor brands but not the other three.

21 80. Moreover, Backblaze mishandled and misused the drives, and there are other  
 22 problems with the blog posts. Seagate's witnesses have explained that log data for drives Backblaze  
 23 claimed had failed showed a high percentage of the drives with No Trouble Found ("NTF")  
 24 indicating that the drives were working properly and the failure rate was not what Backblaze  
 25 reported. (Ex. 17 [Rollings Decl.], ¶ 7.) The boxes or "Pods" into which Backblaze inserted the  
 26 Grenada 3TB drives (the Pod 2.0 design) was highly flawed, and subjected the drives to excessive

27  
 28 <sup>25</sup> Hospodor does not explain how the blog posts are relevant to his discussion of Beta—  
 they are not.

1 vibration and potential mishandling. (*Id.*, ¶¶ 4, 5, 8, 9.) Backblaze **admitted** that it had  
 2 subsequently redesigned the Pod 2.0 to reduce vibration, and that this significantly reduced drive  
 3 failures even over a short period of time. (See [https://www.backblaze.com/blog/180tb-of-good-](https://www.backblaze.com/blog/180tb-of-good-vibrations-storage-pod-3-0/)  
 4 [vibrations-storage-pod-3-0/](https://www.backblaze.com/blog/180tb-of-good-vibrations-storage-pod-3-0/) (stating that changes were made in the transition from the Pod 2.0  
 5 design to the Pod 3.0 design to reduce vibration and that even within a few months, these changes  
 6 resulted in a “*dramatic improvement* in overall system performance along with lower drive failure  
 7 rates.”) This indicates that the long period of time (several years) that the Grenada 3TB drives were  
 8 in the high-vibration Pod 2.0 design was likely a substantial factor in any failures Backblaze  
 9 observed. Backblaze also admits it operated the drives in a commercial, high-workload 24/7  
 10 environment—which is very different and much more stressful to the drives than typical consumer  
 11 desktop use. (See Rollings Decl., ¶ 5)

12 81. Finally, Backblaze reports that it purchased over 80% of its ST3000DM001 drives  
 13 *before* September 2012, and purchased all of them by the end of 2012. (See  
 14 <https://www.backblaze.com/blog/3tb-hard-drive-failure/>.) Seagate approved shipments of Grenada  
 15 BP drives in April and June 2012, and projected Grenada BP production would equal Grenada  
 16 Classic production around September 2012. (Ex. 4 [FED\_SEAG0026751] at p. 26787; Dewey  
 17 Decl., ¶ 18.) This means that almost all of Backblaze’s drives were Grenada Classic drives  
 18 manufactured in 2011 and 2012. Even if the Backblaze blog posts were credited (they should not  
 19 be), the posts could not support conclusions about Grenada BP or BP2 drives, or drives  
 20 manufactured after 2012.

21 **VIII. Hospodor’s Remaining Sections and Evidence Do Not Support Any Claims about the**  
 22 **AFR of the Drives or Hospodor’s Claim that the Drives Were Released Prematurely or**  
 23 **Were ‘Unstable’ and ‘Unreliable’ (Hospodor’s Section IV.I)**

24 82. As explained in the preceding sections, the data and documents Hospodor cites do  
 25 not support his conclusions that any version of the internal, desktop drives had a higher than 1%  
 26 AFR, or that any Grenada drives had a “higher than advertised” AFR. In the remainder of his  
 27 declaration, Hospodor claims that other evidence (related to yield, ECRs, firmware releases, ship  
 28 holds, etc.) shows that the drives were “unreliable” and were “released prematurely.” Importantly,  
 none of the evidence Hospodor cites can support a conclusion that the AFR for any drives was



1 above any particular value, or that the AFR for the internal, desktop drives sold to the public was  
 2 over 1%. Furthermore, the evidence he cites doesn't even support the vague statements that the  
 3 drives were "unreliable" or "released prematurely." With one exception, the evidence he cites is  
 4 also limited to Grenada Classic drives, from 2011-2012. Finally, Hospodor continues to  
 5 misinterpret and/or misrepresent various Seagate documents.

6 **A. Yield Information (Hospodor's Section IV.I.1)**

7 83. In Paragraphs 119 to 126 Hospodor discusses yield and the potential impact on  
 8 reliability for the ST3000DM001 HDDs. Hospodor admits that yields are not part of an AFR  
 9 estimate with the Weibull distribution. (Ex. 11 [Hospodor Depo.], at 236:10-13.) Indeed, yield  
 10 cannot be used to determine if the AFR for a product is above or below a particular number (like  
 11 1%). The yield information Hospodor cites does is not evidence that the AFR was over 1% for  
 12 internal, desktop Grenada drives.

13 84. Moreover, the yield information on which he relies is limited to yield information for  
 14 the Grenada Classic (in 2011 and 2012). (Hospodor Decl., ¶¶ 199-125.) Hospodor references pre-  
 15 release yield information and projections for the Grenada BP drives (in 2012), but does not analyze  
 16 any post-release yield information on Grenada BP or BP2 or any yield information from after 2012.  
 17 (Hospodor Decl., ¶ 126 citing Ex. 3 [FED\_SEAG0026867].) (*See also* Dewey Decl., ¶¶ 20-28.)

18 85. Finally, low yield also does not mean the drives were 'unreliable.' First, alleged low  
 19 yields do not mean that a product is "unreliable" or "defective" as Hospodor claims. Hospodor  
 20 presents no *evidence* to support this claim. Nor does it have clear philosophical support. On the one  
 21 hand, some people argue that if there is less margin in the design and/or manufacturing process, this  
 22 will lead to lower yields and could also result in less field reliability. On the other hand, if tests and  
 23 screening are more stringent than necessary, then this will also lower yields but could be tied to  
 24 better reliability in the field (because only the very best products are allowed to make it to the field).  
 25 If tests and screening are less stringent, yield will be higher, and parts or products that should have  
 26 been rejected will make it to the field where they will fail. In this instance, higher yield could be  
 27 associated with higher failure rates. In other words, there are scenarios in which low yield *could be*  
 28 paired with low reliability, but there are also scenarios in which in which high yield *could be* paired

1 with low reliability, and in which low yield *could be* paired with high reliability. Yield alone is not  
2 evidence of reliability or unreliability.

3       86. Second, Hospodor's analysis cites to "prime" yield numbers, not over-all yield  
4 numbers, which gives a misleading impression that yields were much lower than they actually were.  
5 What Hospodor misses is that modern HDD designs tailor the recording format (and hence areal  
6 density) to the capability of individual head and disk combinations that emerge from the production  
7 line. I can state from my experience working with other hard drive companies over the past 10-20  
8 years that this has been widely practiced for more than fifteen years across the industry, and enables  
9 drive manufacturers to utilize the full variability from production. This has allowed the top areal  
10 density and capacity to be pushed to match the strongest combination of heads and media from the  
11 production line, while using weaker combinations of head and media to be utilized at lower  
12 capacities. In other words, drives that are tested as being able to meet the most stringent head/media  
13 requirements are utilized as 3TB drives. The yields Hospodor references for 3 TB Grenada drives  
14 were the prime yields—the 'cream of the crop' that met the highest areal density media and head  
15 requirements. The balance of the drives were formatted at a lower capacities that were supported by  
16 the capability of the heads and media at a prescribed error rate. (Dewey Decl., ¶ 24.) Drives could  
17 also be reclassified if specific heads or platters were defective by disabling the defective parts. (*Id.*)  
18 This sorting and formatting (called "waterfalling") is an automatic part of the HDD process test code  
19 and ***does not require*** humans to "diagnose, repair and rework hundreds of thousands of defective  
20 disk drives" as Hospodor claims in Paragraph 119. (Dewey Decl., ¶¶ 24-26.) Total throughput  
21 yield is therefore a much higher number. Given Seagate's prime yields, and based on my  
22 experience, I would expect that Seagate achieved throughput yields in the range of 90%, as required  
23 to support the business. There is no reason to believe Seagate did not achieve these throughput  
24 yields. Accordingly, Hospodor's statements that "a 43% yield indicates that the product was  
25 immature, highly unreliable and should not have been released until a substantially higher factory  
26  
27  
28

yield was achieved,” and others to the same effect in the section, are based on incomplete and outdated knowledge about modern HDD design and manufacturing.<sup>26</sup>

87. Third, as Seagate’s witnesses explain, the yields Hospodor cites were from early in production, before production had ramped to full capacity. (Dewey Decl., ¶¶ 23-28.) Seagate expected yields to be low initially and to improve as production volumes increased, and the documents indicate this in fact occurred. (*Ibid.*) Allowing for yield improvement over early production is very common.

**B. Engineering Change Requests (ECRs) Are Not Evidence of AFR or that the Drives Were Unstable or Shipped Prematurely”**

88. In Paragraphs 127-155 Hospodor argues that the number and timing of the engineering change requests (ECRs) for the Grenada Classic drive is evidence that the drive was “unstable” and “released prematurely.”<sup>27</sup>

89. First, the number and pattern of ECRs cannot be used to determine AFR or as evidence that the AFR of the drives was over 1% or any other value.

90. Second, Hospodor’s analysis is restricted to Grenada Classic drives (in 2011 and 2012). Hospodor’s discussion in Paragraphs 127-135 and 137-155 is confined to Grenada Classic drives (and 2011-2012). In a single paragraph (Paragraph 136), Hospodor claims that the Grenada BP had 732 ECRs, of which 696 were designated as “serious” and in his opinion, “this means that problems with the Drive continued.” Hospodor does not support his assertions or present the data. Hospodor does not disclose what the “problems” with the Grenada BP might have been, or how the number of ECRs (serious or otherwise) demonstrated the persistence of any particular “problem” or “problems.” Furthermore, Hospodor does not explain why he thinks the designation of “serious” means there was a “problem” with the drives. My review of the ECRs for the Grenada Classic drives indicates this can’t possibly be the case, since so many ECRs that had nothing to do with

<sup>26</sup> Hospodor’s lack of familiarity with modern manufacturing may be due to the fact that it appears he has not been employed in hard drive manufacturing since 2001, or it may be due to the fact that his background is more focused on software, firmware and systems aspects of hard drives not in-depth experience in manufacturing.

<sup>27</sup> As Hospodor admits, the timing and number of ECRs cannot be used to calculate AFRs or to determine whether the AFR of the drives was above 1% (or any other value). (Ex. 11 [Hospodor Depo.] 251:18-21.)



1 quality or reliability were designated “serious.”<sup>28</sup> Furthermore, Hospodor conclusions are  
 2 unsupported by any credible evidence.

3 91. Third, neither the number nor pattern of ECRs is surprising or problematic in my  
 4 experience, and Hospodor’s contrary opinion appears based on nothing more than an outdated  
 5 conception of how hard drive manufacturing ‘should’ be done. Hospodor also cites a few individual  
 6 ECRs he claims show problems with the Grenada Classic drives, but in most if not all instances,  
 7 Hospodor appears to misinterpret (or misrepresent) the ECRs. The ECRs do not indicate any  
 8 pervasive issues with the drives.

9 92. In Paragraphs 127-135, Hospodor references ECR data for the Grenada Classic, and  
 10 presents his analysis of the spreadsheet in FED\_SEAG0027240 which lists the ECRs for the  
 11 Grenada Classic drive. In Paragraphs 128-130 and his Figure 18, Hospodor presents a summary of  
 12 the counts and statistics for various categories of ECRs. However, he does not explain why he  
 13 chose to sort according to some fields (some ECR properties) but not others, and the ones he chose  
 14 appear irrelevant. For example, it is irrelevant if a certain percentage of ECRs involve “electrical”  
 15 or “mechanical” components of the drives, if the reason for those ECRs was simply to add  
 16 additional sources, or respond to customer requests, or to adapt the drives to changing  
 17 circumstances, or to lower costs or improve yields, etc. (*See* Netel Decl., ¶¶ 22-27 (explaining that  
 18 ECRs are simply one measure of the complexity of the supply chain, the number of factories in  
 19 which Seagate manufactured the drives, and the length of time drive designs are now kept in  
 20 production); Dewey Decl., ¶¶ 29-33 (similarly explaining that the number of ECRs is a reflection of  
 21 the manufacturing complexity, and Seagate’s adaptation of the drives to changing customer  
 22 demands, environments and uses of the drives).) In my opinion, a relevant sort of the data in the  
 23 spreadsheet should have been done on the “**ECR Reason**” field—to examine the reasons for the  
 24 ECRs. I have done this, as shown below in Figure 5. This Figure shows that “**Quality/Reliability**”  
 25 ***was the reason for only 3.81% of the total number of ECRs***, indicating that, in fact, problems with  
 26 quality or reliability motivated very few of the ECRs. Customer Unique Code CC accounted for  
 27

28 <sup>28</sup> Indeed, Seagate’s witnesses explain that they designated ECRs as “serious” for any  
 number of reasons, and that it just meant the ECR shouldn’t be ignored. (Dewey Decl., ¶ 35.)

8.5%. (Customer code simply means an ECR done in response to a customer request. (Ex. 11. [Hospodor Depo.] at 249:12-16.) The second most common Reason was to “Allow Purchase/Build of Evaluation Parts,” which would be normal in the course of development and high volume manufacturing. Nothing in Hospodor’s analysis supports his conclusions.

<b>Grenada</b>			
<b>ECR Reasons</b>	<b>Count</b>	<b>Count%</b>	<b>CumCount%</b>
Improvement - Design Engineering	260	25.42%	25.42%
Allow Purchase/Build of Evaluation Parts	119	11.63%	37.05%
Document update	115	11.24%	48.29%
Customer Unique Code CC	87	8.50%	56.79%
<b>Correct error</b>	<b>68</b>	<b>6.65%</b>	<b>63.44%</b>
Improvement - Manufacturing Process	55	5.38%	68.82%
Initial Release	54	5.28%	74.10%
Consume Inventory	49	4.79%	78.89%
Incorporate Part/Assembly not meeting documentation requirements	41	4.01%	82.89%
<b>Improvement - Quality/ Reliability</b>	<b>39</b>	<b>3.81%</b>	<b>86.71%</b>
Label Update	19	1.86%	88.56%
Inactivate CCs	18	1.76%	90.32%
Customer Unique Code/Label CC	13	1.27%	91.59%
Customer Request	12	1.17%	92.77%
Change Status of BI	11	1.08%	93.84%
Commonality	11	1.08%	94.92%
Unique Test Requirements	10	0.98%	95.89%
Manufacturing Process/yield improvement	9	0.88%	96.77%
Customer Unique Label CC	8	0.78%	97.56%
ASL - Add/Change Process	6	0.59%	98.14%
Customer Change Control CC	5	0.49%	98.63%
Cost Reduction	4	0.39%	99.02%
ASL - Add/Change in Sub-Assemblies Suppliers	3	0.29%	99.32%
Customer Unique Code/Congen/Label CC	2	0.20%	99.51%
ASL - New Part	1	0.10%	99.61%
New Process station	1	0.10%	99.71%
Ship Parts/Assy Prior to ECR effectivity	1	0.10%	99.80%
Improvement - Tooling	1	0.10%	99.90%
Customer Unique Congen/Label CC	1	0.10%	100.00%
<b>Grand Total</b>	<b>1023</b>	<b>100.00%</b>	

**Figure 5.** Pareto of Reasons for Grenada ECRs based on the spreadsheet from FED\_SEAG0027240.

93. Hospodor claims that the plots in his Figures 19 and 20 are from the same spreadsheet discussed above. However, that spreadsheet does not have a date field, and Hospodor

1 does not cite to any other document from which he obtained date information. Hospodor was  
2 unable to explain in his deposition the source of the data for Figures 19 and 20 and the explanation  
3 he offered is not correct, since the spreadsheet he cites does not contain tabs, and is not specific to  
4 any month, but instead contains all ECRs regardless of month. (Ex. 11 [Hospodor Depo.] at 248:4-  
5 19.)

6       94. Nonetheless, even crediting that Hospodor might have some legitimate explanation  
7 for how he created these graphs, the basic distribution and timing of the ECRs shown do not seem  
8 unusual in my experience. The Grenada Classic drives were approved for OEM/Disty release near  
9 the peak of the ECRs in Oct/Nov 2011. The volume of manufacturing for the drives would have  
10 been low at that point and was expected to ramp through at least the second quarter of 2012.  
11 (Dewey Decl., ¶ 23; Ex. 1 [FED\_SEAG0026697] at p. 26700 (production in the last quarter of 2011  
12 was expected to be only 79,995 of the 3TB drives, which was expected to grow to 618,414 3TB  
13 drives in Q2 2012, and similarly the higher yielding 1TB drives were expected to ramp from  
14 110,830 drives in Q4 2011 to over 3.3 million in Q2 2012).) Accordingly, the bulk of the ECRs  
15 would have happened while production of the Grenada drives was increasing. This is fully  
16 consistent with my experience of modern manufacturing practices in which multiple sources and  
17 suppliers of each part continue to be qualified as production is ‘ramping.’ Hospodor opined in his  
18 deposition that in his experience, all suppliers and sources are qualified before a drive is approved  
19 for manufacturing, and at Quantum in the late 1990s, suppliers and sources would never be qualified  
20 during production. (Ex. 11 [Hospodor Depo.] at 107:3-16; 108:15-109:6; 231:25-234:10.) This  
21 belief appears to be the main basis for Hospodor’s assertion that the timing of the Grenada Classic  
22 ECRs was suspicious. I worked at Quantum at the same time as Hospodor. At that time, we would  
23 release new drives several times a year, so it made more sense to qualify suppliers before drive  
24 release, and if a new supplier or source was qualified after one drive was released, we would just  
25 wait a few months to incorporate that new supplier or source into the next drive that was under  
26 development. That system is no longer relevant or applicable. These days, manufacturers keep  
27 drives in production for much longer—several years—and don’t release new drives several times a  
28 year. Therefore, drives are designed to be flexible and adaptable, so that they can be modified over



1 the course of the years that they are in production to meet changing circumstances. Moreover,  
 2 manufacturers now anticipate that they will need to continuously qualify suppliers and sources (even  
 3 after product launch) to meet volume production, to improve costs and yields, and for any number of  
 4 other reasons.<sup>29</sup> (See Netel Decl., ¶¶ 22-27; Dewey Decl., ¶¶ 29-33.) Hospodor's opinions are  
 5 based on notions of drive development and manufacturing that are nearly two decades out-of-date.

6 95. Furthermore, I reviewed the available details in the ECR data for several of the  
 7 specific ECRs Hospodor selected in his declaration. I found the following problems:

- 8 (a) [REDACTED]  
 9 [REDACTED]  
 10 [REDACTED]  
 11 (b) [REDACTED]  
 12 [REDACTED]  
 13 [REDACTED]  
 14 (c) [REDACTED]  
 15 [REDACTED]  
 16 [REDACTED]  
 17 (d) [REDACTED]  
 18 [REDACTED]  
 19 (e) I agree with Dewey's explanation of the ECRs at issue in Hospodor Paragraphs  
 20 147-155 (ECR0148346, ECR 0149074, ECR0149636). (Dewey Decl., ¶ 36(e).)  
 21 Hospodor's explanation of these ECRs does not match the text of the ECRs or  
 22 any other evidence I have seen.

23 **C. Hospodor's Discussion of Firmware Revisions Does Not Support His Claims**  
 24 **(Hospodor's Section IV.I.2(c))**

25 96. In Paragraphs 156-168 Hospodor claims the number of firmware releases (12  
 26 releases) supports his conclusion that the Grenada drives were an "abnormally unstable product."<sup>30</sup>  
 27 He also points to two specific firmware releases allegedly indicating problems with the drives.

28 <sup>29</sup> In no case are *unqualified* parts or vendors used in product for sale (and at the start of  
 production, all parts must be qualified with qualified vendors). Regardless of the timing of  
 qualification, sources, suppliers and parts are held to the same standards. (Netel Decl., ¶ 23.)

<sup>30</sup> The number of firmware releases cannot be used to determine the AFR of drives, and it  
 does not show whether the AFR of the drives was over 1% (or any other number).

1           97. First, the number of firmware releases cannot be used to determine AFR, and it is not  
2 evidence that the AFR of the drives was over 1% or any other value.

3           98. Second, the only firmware releases that Hospodor ties to possible “issues” with the  
4 drives both relate to the Grenada **Classic** drives in **early 2012**, and neither indicates anything more  
5 than limited issues with *that version* of the drive that were fixed early in 2012. (See Paragraphs 100,  
6 101 below.)

7           99. Third, Hospodor’s claim about the overall number of firmware releases is not  
8 reasonable. In paragraph 157 Hospodor says “The ST3000DM001 underwent at least 12 firmware  
9 updates.” He neglects to explain that this total includes the initial firmware release that went with  
10 each of the three versions of the Grenada drive, the Grenada Classic, GrenadaBP, and GrenadaBP2.  
11 In other words, each of these drive versions would have an initial firmware release to go with the  
12 new parts and electronics contained within each version of the drive. Excluding these three releases,  
13 there were 3 firmware revisions for Grenada Classic, 4 for Grenada BP, and 2 updates for Grenada  
14 BP2. (FED\_SEAG0018735.) Hospodor admits that a few firmware releases per drive is not  
15 exceptional (Hospodor Decl., ¶ 161), so viewed in this way, the number of firmware updates is not  
16 excessive, and does not support Hospodor’s claims. (See also Dewey Decl., ¶ 37.)

17           100. As noted, Hospodor points to only two firmware releases that he claims show  
18 problems with the drives, both of which were firmware revisions for the Grenada Classic drives in  
19 early 2012. The firmware update of 1/11/2012 for Grenada Classic described in Hospodor’s  
20 Paragraphs 163 to 166 includes a correction for an SOC test port that was left unterminated.<sup>31</sup> This  
21 sort of bug or failure is ‘repairable’ by resetting the HDD or recycling power. As stated in the  
22 change log, “This issue does not result in loss or compromise drive data.” (FED\_SEAG0018735.)  
23 This sort of failure is annoying and needs to be fixed, but will be tolerable if the time between  
24 events is long. In fact an electromagnetically noisy environment is necessary to initiate the problem,  
25 so it may never occur for most users. (See also Dewey Decl., ¶ 38.) It should not result in a ‘dead’  
26 drive or lost data.

27 \_\_\_\_\_  
28           <sup>31</sup> In my experience it is not uncommon that this error might occur with complex systems  
such as an HDD.

101. The firmware update of 4/23/2012 described in Hospodor's Paragraph 167 and 168 corrects a "corner case in the drive cache search hardware." It is identified as a hardware race condition in the interface ASIC or SoC. Race conditions are serious, but corner cases are *very rare* and can take a long time to identify and debug because they depend on just the right sequence of events to occur. As such they will occur in the field very infrequently too, and affect very few customers. (See also Dewey Decl, ¶ 39.) The firmware update in question made several other improvements (including yield improvements). It is unclear that Seagate would have done the firmware revision simply to address the issue Hospodor identifies. Hospodor's characterization of the change is greatly over-blown.

**D. Hospodor's Discussion of Ship Holds Does Not Support His Opinion (Hospodor Section IV.I.2(d) and IV.I.d(e))**

102. In both Sections IV.I.2(d) and IV.I.2(e) (Paragraphs 169-180), Hospodor discusses ship holds for the Grenada Classic drive in 2011-2012.

103. First, the ship holds Hospodor cites are *limited to 2011-2012*, and with one exception, Grenada *Classic*.<sup>32</sup>

104. Second, the ship hold procedure exists to catch possible problems and *keep them from reaching consumers*. It is common that a new product at a new areal density, in the case of Grenada Classic 1 TB/disk, will experience difficulties ramping production. Inevitably new problems arise as volumes increase from 1,000s to 10,000s to 100,000s to 1,000,000. Hospodor's evidence—confined to 2011 and 2012—is consistent with this. Furthermore, with the proper systems in place these can be found in the factory and fixed before customers see them. The issues Hospodor enumerates in subsections I.2.d and I.2.e highlight Seagate's controls and the actions taken by its organizations to that effect. (See Netel Decl., ¶¶ 28-39.) By contrast he would have us believe this is evidence that "the ST3000DM001 [drives were] was unreliable, unstable, and defective". The ship holds however, are evidence of drives being withheld from the market—*it is*

<sup>32</sup> Document FED\_SEAG0054864, dated July 19, 2012, references Grenada BP. The remainder of the ship holds Hospodor cites apparently reference Grenada Classic, and most predate the release of Grenada BP. Hospodor also cites two other documents from 2012: Exhibit 3 [FED\_SEAG0026751], at 26785, which concerns ORT on Grenada Classic drives in June 2012, as discussed above in Paragraphs 63, 64 ; and FED\_SEAG0024743, which is a May 2012 document mentioning apparent comments of two Grenada Classic OEM customers..



1 *not evidence that problematic or “unreliable” drives were shipped to consumers.* The evidence  
 2 instead illustrates Seagate’s organizational resolve to find and fix issues as they arise.

3 105. [REDACTED]  
 4 [REDACTED]  
 5 [REDACTED]  
 6 [REDACTED]  
 7 [REDACTED]  
 8 [REDACTED]  
 9 [REDACTED]  
 10 [REDACTED]

11 **E. Hospodor Does Not Support His Claim that Seagate Documents “Acknowledge”**  
 12 **that the Drives Were “Unstable, Unreliable, and Defective” (Hospodor’s**  
 13 **Section IV.I.2(f).)**

14 106. [REDACTED]  
 15 [REDACTED]  
 16 [REDACTED]  
 17 [REDACTED]  
 18 [REDACTED]  
 19 [REDACTED]  
 20 [REDACTED]  
 21 [REDACTED]

22 **F. A Few Changed Specifications for the Drives Do Not Support Hospodor’s Claim**  
 23 **that the Drives Were “Unreliable” (Hospodor’s Section IV.J)**

24 107. In this section, Hospodor argues that changes in a few of Seagate’s specifications for  
 25 the drive—most at the very end or after the end of the class period (February 2016)—somehow  
 26 show that there were problems with the drives. The conclusion does not follow from the evidence  
 27 Hospodor cites. Changes in published specifications are not evidence that an HDD is unstable  
 28 or unreliable. Changes frequently occur for many high technology products over time. Spec-sheets

1 typically include a clause that says “specifications are subject to change at any time without notice.”  
2 It is my experience that specifications will evolve over the life of a product, especially as new  
3 models are introduced over many years, as in this case, where various iterations of the drives were  
4 produced over 5-6 years. Furthermore, in some instances, Seagate modified the specifications from  
5 upper bounds that were so high they would be impossible to reach. An upper bound that is so high  
6 does not provide any useful information to users since it is impossible to achieve or will never be  
7 reached. For example, an instruction that a drive should not be stored at the center of the Sun does  
8 not provide useful information to users about how, and under what conditions, they should store  
9 their drives. In some instances, Seagate’s prior specification was of this type, and Seagate modified  
10 it to bring it more in the range of possibilities. These types of changes appear to me to be driven by  
11 a desire to make the specifications more relevant or useful.

12 108. Hospodor mentions a handful of specific specifications he claims were changed in a  
13 way that indicate that the drives were “unreliable.” As explained in the following paragraphs,  
14 Hospodor is wrong.

15 109. In Paragraph 199 on Maximum Case Temperature, Hospodor says that “[t]esting  
16 performed in 2011 showed that the ST3000DM001 case temperature was 38°C above ambient.” He  
17 neglects to mention the report is for the SBS Raptor product *enclosure* with an HDD inside. See  
18 Exhibit 16 [FED\_SEAG0009095] which clearly concerns testing the drive enclosure for Raptor with  
19 the drive in it. In fact, if the drive were not in the enclosure, then this document couldn’t relate to  
20 the Raptor product, since the Raptor product was an external, USB “box.” This product was not  
21 released at the time because of this design problem with the enclosure. (Dewey Decl., ¶ 12.)  
22 Hospodor’s entire argument about case temperature rests on his mischaracterization of the  
23 documents concerning the Raptor enclosure. Since that product was not released at that time, the  
24 fact that it was over-temperature in that test is irrelevant. Hospodor’s subsequent calculations and  
25 conclusions are therefore seriously flawed.

26 110. Hospodor discusses Maximum Wet Bulb Temperature (“WBT”) at paragraph 200.  
27 In this case, Seagate’s prior specification—37.7°C—describes a condition that is *lethal to*  
28

1 *humans*.<sup>33</sup> It seems reasonable that it would have been revised downward. The new specification  
 2 (26°C) is not “onerous” as Hospodor claims. First, Hospodor’s math is wrong. The National  
 3 Weather Service provides a calculator that shows that a an ambient temperature of 83°F at a relative  
 4 humidity of 75% does **not** give a WBT of 78.8°F or 26°C as Hospodor claims. In fact, at 83°F, the  
 5 relative humidity would have to be over 83% to reach Seagate’s WBT specification.<sup>34</sup> Second, wet  
 6 bulb temperatures of over 80°F (26.6°C) are still dangerous to human health and are rarely exceeded  
 7 in the US.<sup>35</sup> Thus, Seagate’s new specification should not be onerous. The new limit describes  
 8 conditions that are miserable, verging on dangerous to human health, and rarely occur in the US, and  
 9 so few consumers will be operating their drives in this environment.

10 111. In Paragraph 201, Hospodor discusses the Unpackaged Storage Specification.  
 11 Unpackaged storage is not the same as storage in the hermetically sealed package in which Seagate  
 12 ships its HDDs. The primary risk of unpackaged storage is absorbing water into the HDA in high  
 13 humidity environments. This is primarily a specification for retailers, not consumers. Again, since  
 14 a wet bulb temperature of 26°C verges on dangerous to human health *and is rarely exceeded in the*  
 15 *US*, Hospodor does not explain how a limit of *60 days, unpacked*, in these conditions is an  
 16 unreasonable limitation.

17 112. In Paragraphs 202 to 206 Hospodor addresses the Workload Rating contained in the  
 18 Product Manual. I agree that the specification is poorly written and even ambiguous, but I don’t  
 19 think it was intentional. The main point of this specification appears to be to say that workload is  
 20 limited to 55TB/year.<sup>36</sup> This is reasonable, and did not change over the course of the relevant

21  
 22 <sup>33</sup> See <http://advances.sciencemag.org/content/3/8/e1603322.full> (wet bulb temperature “of  
 23 around 35°C for even a few hours will result in death even for the fittest of humans under shaded,  
 24 well-ventilated conditions”).

<sup>34</sup> See [https://www.weather.gov/epz/wxcalc\\_rh](https://www.weather.gov/epz/wxcalc_rh) [using a barometric pressure of 30 in, which  
 25 is considered normal]. Hospodor’s calculation regarding Houston TX is also inaccurate.

<sup>35</sup> Houston, Texas is one of the hottest and most humid metropolitan locations in the world.  
 26 Singapore is the worst. Houston, Texas is hardly representative of conditions elsewhere in the US.  
 27 See also <https://www.nytimes.com/2015/06/07/opinion/sunday/the-deadly-combination-of-heat-and-humidity.html> (“we found that over the period from 1981 to 2010, the average American  
 28 experienced about *four* dangerously humid days, with wet-bulb temperatures exceeding *80*  
*degrees.*”)

<sup>36</sup> I think the confusing wording of this specification reflects the technical and marketing  
 team struggling with a new idea and trying to get it right. Moreover, the specification for a limited  
 workload per year (<55 TB) was relatively new for HDDs. It has been adopted from Flash storage



1 period. Rather, Hospodor's critique of the 55 TB/year limitation is based on misleading  
 2 calculations. (See Hospodor Paragraph 206.) A comparison to MPEG video on DVD is helpful. A  
 3 single layer DVD has a 4.7 GB capacity and ~2 hour play time. This is about 5 Mbps at HD quality.  
 4 By comparison, 55 TB/year yields about 150 GB/day of data transfers. This is the equivalent of ~32  
 5 ***DVD movies per day***. I don't think this is a severe restriction on the typical consumer, even in a  
 6 small RAID home media server.

7 113. Furthermore, Hospodor misrepresents the importance of the reference to 8760 POH.  
 8 While the Product Manual contained a reference to 8760 POH, it did not specify an AFR (or MTBF)  
 9 until 2015, at which point it is specified <1% AFR ***for 2400 POH***. (Schweiss Decl., ¶ 10, 11 and  
 10 Exs. 2-12.) Prior to 2015, when the Product Manual referred to 8760 POH, there was no AFR  
 11 statement in that manual. (*Ibid.*) Some Data Sheets between 2011 and 2015 specified an AFR of  
 12 <1%, but in conjunction with a 2400 POH per year. (Payne Decl., ¶ 12, 13, Exs. 26, 27; Schweiss  
 13 Decl., ¶¶ 12, 13, Exs. 17, 18.)

14 **IX. Hospodor Does not Identify Any Defect or Other Issue Common to the Different Drive**  
 15 **Versions, Products, or Across the Class Period**

16 114. Hospodor admits he does not identify any problem common throughout the class  
 17 period (2011-2016), or common to the products and drive versions at issue (Classic, BP, BP2). (Ex.  
 18 11 [Hospodor Depo.] at 49:7-52:25, 54:17-55:5, 125:19-128:14; 255:3-256:16.) However, in his  
 19 declaration, Hospodor makes numerous references to "head related" and "contamination" "issues."  
 20 To avoid any doubt on this issue, Hospodor does not present any evidence that any such issues are  
 21 common to or among any of the drives, or across the class period. Furthermore, Hospodor's various  
 22 statements about "head related" and "contamination" "issues" are not technically sound, and  
 23 suggests he does not understand hard drive operation or failure modes.

24 115. In Paragraph 79, Hospodor claims that 23 of the 129 failures listed in the Grenada  
 25 Classic SBS SAD (Exhibit 1 [FED\_SEAG0026697] on pp. 26704-05), were "head instability."

26 devices where it is common due to endurance limitations for the underlying technology. HDD  
 27 manufacturers have found it necessary to employ this workload limitation as new technology to  
 28 increase areal density has been developed that impact endurance for magnetic recording. It also has  
 become necessary because an increasing number of customers have been trying to (mis)use  
 consumer class products in data center applications where workloads are high and operations are  
 24/7.

1 Hospodor suggests that the head instability was due to contamination or lubrication problems.  
2 Hospodor also claims that “head-related failures, in addition to contamination, was a recurring issue  
3 with the Drives.” These claims are flawed. In my experience head instability (for magneto-resistive  
4 head technology) refers to an “unstable” *electrical output signal* from the read-write head due to  
5 issues related to the pinned magnet and/or domain noise in the sensor. This is consistent with the  
6 reports of Seagate employees. (Dewey Decl., ¶ 9, 16; Almgren Decl., ¶ 15.) Furthermore, contrary  
7 to Hospodor’s assertions, contamination and lubrication issues are not primary causes of head  
8 instability. The occurrence of some head and media failure does not imply a problem with the  
9 drives or that these failures are related or are related to any other failures in any other versions of the  
10 drives.

11 116. Moreover, the documents Hospodor cites demonstrate that **the numbers of Grenada**  
12 **drives exhibiting head instability was quite small** and refute any claim that head instability was a  
13 “recurring” “issue” or “problem” with the drives. In the case of the Grenada *Classic* drives at issue  
14 in Paragraph 79, Hospodor cites Exhibit 1 [FED\_SEAG0026697], at page 26704-05. This  
15 document states that Seagate observed failures due to head instability in MAT 1.2 and 1.3 testing.  
16 However, the document also clearly states that Seagate made changes to correct the problems, and  
17 that MAT 2.0 testing validated that Seagate had reduced the problem by at least 74%. (See Figure 6  
18 below (Ex. 1 [FED\_SEAG0026697] at p. 26704.)) This occurred before the drive was approved for  
19 shipment to consumers. (See Ex. 1 [FED\_SEAG0026697] at p. 26704.) Seagate’s employee  
20 testified about this in his deposition. (Ex. 13 [Almgren Depo.] at 194:3-9.) Hospodor apparently  
21 ignores the plain meaning of the document (and Seagate’s deposition testimony) when he claims  
22 that “head instability” was a problem at this point.

23  
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Issue				
SPPL-043: Head Instability MAT1.2/1.3	Fix Validation	# of Failures	% Fail	Eff. Fact Demo'd Po
	Validation based on MAT 1.2/1.3/B/C failure rate in first 180 hours vs. MAT 2.0	23	1243%	74%
	Validation of 11 failures in Kerat with new			

**Figure 6** (Ex. 1 [FED\_SEAG0026697] at p. 26704.)

117. Similarly, “head instability” was *not* a prevalent problem for the BP or BP2 drives. (See Almgren Decl., ¶¶ 16, 17.) Exhibit 4 [FED\_SEAG0026751], page 26757, contains a reliability summary for Grenada **BP** drives. It states that, prior to any corrective actions, 5 drives out of 1073 drives tested—only 0.47%—failed due to “head instability.” Furthermore, since these drives were subjected to 1008 hours (42 days) of testing, or the equivalent of ~3.5 years of use, this gives roughly 0.13% drives failing due to head instability per year. (Almgren Decl., ¶ 17.) Finally, in his Paragraph 116 Hospodor claims Exhibit 5 [FED\_SEAG0057277], p. 57324, shows that “the top ‘issue’ in the above chart [for Grenada **BP2**] is related to contamination, and the third issue is head-related.” However, that page shows that, before any corrective actions, 6 of 1058—only 0.6%—of Grenada BP2 drives failed because of particle/contamination issues. (This is roughly 0.2% per year of use.) The document also shows that the “third issue” was the failure of **1 drive out of 1058**—only 0.095%—due to head stability issues. Therefore, while “head instability” was listed as a failure mode for each version of the Grenada drives, most of the head instability issues were fixed *before* the Grenada Classic was released, and the percentage of Grenada BP and BP2 drives with head instability issues was very small, even before the corrective actions that reduced the problems even further.

118. Hospodor’s claim that “contamination, was a recurring issue” is similarly unsupported by the evidence. Hospodor cites to only a scattering of unconnected documents that



1 mention contamination—like the document discussed above that mentions ‘contamination’ in the  
 2 BP2 test results. These scattered references don’t support a conclusion that there was anything  
 3 wrong with the drives, or Seagate’s quality control or manufacturing. “Contamination” is a non-  
 4 specific term that can mean any number of *unrelated* phenomena. (Dewey Decl., ¶ 9; Almgren  
 5 Decl., ¶¶ 17, 20.) In my experience, there can always be some contamination-related failures in any  
 6 group of drives, and hard drive manufactures are always striving to reduce contamination.  
 7 Hospodor doesn’t identify any specific kind of contamination that was a common problem for the  
 8 Grenada drives, and the documents he cites don’t identify any such problem either. There is simply  
 9 no negative implication that could be drawn from the few, scattered and unrelated references to  
 10 “contamination” that Hospodor notes.

11 119. In Paragraph, 82, Hospodor attempts to equate “degraded head” and “particle induced  
 12 media damage” with a “Head Crash”. He claims they are “among the top failures” as well. Neither  
 13 of these statements are reasonable nor do they comport with the entries in the FE tables based on my  
 14 inspection. “Degraded heads” and “particle induced media damage” are the 3rd and 4th most  
 15 common failures, contributing 5 and 3 of 47 total failures—which is 11% and 6% *of failures*,  
 16 respectively. Since 1360 drives were tested, only 0.36% and 0.2 % of the drives that were tested  
 17 failed for these reasons. These are not overwhelming problems. Moreover, “degraded heads”  
 18 “particle induced media damage” and “Head Crash” are not related phenomena. The degraded  
 19 heads appear to be related to TA events (Thermal Asperities due to imperfections in the disk). The  
 20 Corrective Action sounds like adjustment of the disk burnishing process to reduce the disk  
 21 asperities. Particle induced media damage could be caused by any number of types of particles from  
 22 any number of unrelated sources or causes. (Dewey Decl., ¶ 16.) Neither “degraded heads” nor  
 23 “particle induced media damage” are or imply “head crash”—which is a specific and catastrophic  
 24 failure mode that would have been listed had it occurred.

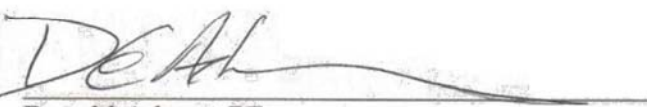
## 25 **X. Supplementation of Opinions**

26 120. The opinions expressed herein are my own, based on my current understanding of the  
 27 facts and circumstances surrounding this matter and my review of the information listed in  
 28 Appendix 2. I understand that discovery is continuing and I reserve the right to supplement this

1 declaration or revise my opinions in light of additional information or documents that may be  
2 brought to my attention. I will consider any criticisms of my opinions or bases for my opinions  
3 brought to my attention or offered by experts retained by Plaintiffs, which may cause me to revise or  
4 supplement my opinions.

5 I declare under penalty of perjury under the laws of the State of California that the foregoing  
6 is true and correct.

7 Executed on this 5<sup>th</sup> day of January, 2018, at Pleasanton, California.

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10 Donald Adams, PE  
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# APPENDIX 1



## Consultant Curriculum Vitae

**Donald E. Adams, PE**

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### Expertise

- Embedded Systems Design and Development
  - Hard Disk Drives
  - Data Storage Systems
  - Analog, RF and Digital Circuit Design/Analysis
  - E&M Fields and EMC problems
  - Probability, Statistical Analysis and DOE
  - Data Communication Systems
  - Magnetic Recording Systems
  - Control Systems and Motor Controls
  - Project Management
  - Phase Locked loops & Delay Locked Loops
  - ADC/DAC and Digital/Firmware Controls
  - Power Converters, Controls and management
  - Modem Sensors and MEMS Sensors
  - AC/DC Magnetic Motors and Electrostatic MEMS Motors
  - Analog and Digital Video
  - Programming: Python, C, Basic, Assembly, Fortran, Matlab, SPICE, Excel
- 

### Professional Summary

#### Employment History

From: 2009 **Adams & Associates Consulting**

To: Present Pleasanton, CA

Position: *Independent Consulting Engineer*

Technical and business development services specializing in electronic systems for data storage, MEMS, consumer products and electric power/energy. Subject matter expert and witness for patents and cases involving electrical/electronic engineering.

From: 2011 **Western Digital**

To: 2015 Irvine, CA

Position: *Sr. Principal Engineer*

Electronic architectures and system requirements specifications for power management in HDD and Flash storage systems. Advanced electronic system architecture development. SI, PI and EMC consulting. Special projects management. New graduate engineer training and mentoring.

## Consultant Curriculum Vitae

From: 2004 **NanoChip**  
To: 2009 Fremont, CA  
Position: *Vice President Engineering*  
Managed all engineering work and a Joint Development Program with Intel.

- Completed research and built an engineering team for the development of a probe storage memory device.
  - The technology is based on atomic force probes with ferroelectric media built with MEMS structures and processes in a system similar to a disk drive or HDD.
- This team made several significant technology and architectural breakthroughs which resulted in more than 75 patent applications.
- Technical feasibility was demonstrated by early 2008 and the team was moving into full product development when funding ran out at the end of 2008.

From: 2001 **Maxtor Corporation**  
To: 2004 Milpitas, CA  
Position: *Senior Engineering Director & Principal Engineer*  
Managed technology transfers and pre-development projects in the Advanced Technology Group.

- Finished Printed-Media-Self-Servo-Write transfer work started at Quantum after the merger with Maxtor. A derivative was implemented for all Maxtor product lines.
- Led the pre-development team for a 2.5 inch mobile computing HDD platform.
  - As an outgrowth of the mobile computing work I became the power management leader for all new products.

From: 1996 **Quantum Corporation**  
To: 2001 Milpitas, CA  
Position: *1999-2001: Senior Engineering Director*  
Co-founded the Consumer Electronics Business Unit as Chief Engineer. The group was chartered to find new non-PC applications and business opportunities.

- Led investments and co-development with TIVO, Replay, Panasonic and other brand name consumer electronics companies that created Personal Video Recorders and Digital Audio Jukeboxes.
  - Investments returned more than \$30M in the first 18 months.
- Developed core technology capabilities for digital video and audio data stream management. 1394AV technology and products were also developed and demonstrated.

## Consultant Curriculum Vitae

- Ten patent applications came out of the group and several have been issued. Most of the technology has since been incorporated in all HDD product lines. (Silent seeks, embedded file systems, capacity and content security)
- Moved to the Advanced Technology Labs to lead the integration of Printed-Media-Self-Servo-Write technology, a critical new manufacturing technology, into multiple products across the entire business.
  - This technology reduced the incremental capital needed to produce HDDs by more than \$50M per year.

### *1996-1999: Engineering Director*

Director for two development teams comprising more than 100 engineers and extended teams from manufacturing, process engineering, test engineering, materials, and marketing. Worked directly with MKE, Quantum's manufacturing partner in Japan. Annual budget >\$16M.

- Delivered four high volume 5.25" HDD products. Production yields were over 90%. Volume was ~1 Mu/quarter for each and generated over 15% gross margins.
- Concurrently advised two additional cross functional teams that developed two more high volume 3.5" HDD products.
- Served as HDD architect in the product and technology planning process for 1 year.
- Initiated and led several technical task teams that tackled critical multi-functional problems for the business division. (FIT, SMART, Sing-no-spin, Adapt' RO-Correction)

From: 1993      **SyQuest Technology**  
 To: 1996      Fremont, CA  
 Position: *Engineering Vice President*

From: 1990      **Iota Memories**  
 To: 1993      Santa Clara, CA  
 Position: *Vice President Engineering & Co-Founder*  
 Private start-up developing data storage products acquired by SyQuest.

From: 1986      **Maxtor**  
 To: 1990      San Jose, CA  
 Position: *Program Manager & Read-Write Engineer*

From: 1983      **Tulin**  
 To: 1986      San Jose, CA  
 Position: *Engineering Director & Read-Write Engineer*



## Consultant Curriculum Vitae

From: 1981      **Ampex**  
 To: 1983      Redwood City, CA  
 Position: *Senior Staff Engineer, Read-Write*

From: 1978      **Memorex**  
 To: 1981      Santa Clara, CA  
 Position: *Senior Electronic Engineer, Read-Write Channels*

From: 1973      **Amdahl**  
 To: 1978      Sunnyvale, CA  
 Position: *Test Equipment Development Manager, Senior Test & Associate Engineer*

### Consulting History

From: 10/17      **Sentient Energy**  
 To: present      Burlingame, CA  
 Duties: Review of IEEE 495 testing for Fault Circuit Indicator product.

From: 3/12      **Intel**  
 To: 9/12      Santa Clara, CA  
 Duties: System architecture development and design reviews.

From: 4/10      **Samsung, SISA**  
 To: 9/11      San Jose, CA  
 Duties: Advisory engineer for HDD technology and magnetic recording. Signal integrity evaluation of high speed DDR2 buss and recommendations to improve products and the development process.

From: 3/11      **Superstar Productions**  
 To: 6/12      Miramar, FL  
 Duties: Hardware and firmware development using IRdA and a 16 bit microcontroller for a consumer electronics product.

From: 2/11      **Test Equipment Plus**  
 To: 12/11      La Center, WA  
 Duties: Development of MEMS based thermocouple RF and Microwave power sensor.

From: 3/10      **Voxis for Topcon**  
 To: 12/10      Richmond and Livermore, CA  
 Duties: Developed prototype hardware and MatLab routines for a new machine vision feature to be used on Total Stations/Scanner tools for civil engineers and surveyors. Prototype was successfully demonstrated and field tested.

## Consultant Curriculum Vitae

From: Summer **Private Investor**  
09

Duties: Evaluation and development of a prototype tracking solar thermal electric power converter based on a concept using the Seebeck effect.

### Patents

<u>Patent Number</u>	<u>Issue Date</u>	<u>Title</u>
9,422,668	9/13/2016	Adaptive Power Management Control with Performance Feedback
9,280,200	3/8/2016	Automatic Peak Current Throttle of Tiered Storage Elements
8,264,941	9/11/12	Arrangement and Method to Perform Scanning Readout of Ferroelectric Bit Charges
7,796,493	9/14/10	Cantilever on Cantilever (MEMS) Structure
7,738,350	6/15/10	Probe Storage with Doped Diamond-like Carbon Medium and Current Limiter
7,310,196	12/18/07	Parking a Transducer Responsive to a Park Signal
7,280,301	10/9/07	Temperature Estimator for Electronic Device
7,196,862	3/27/07	Coherent Phase Data Segment Layout in Data Storage Device
6,487,646	11/26/02	Apparatus and Method Capable of Restricting Access to Data Storage Device
6,195,732	2/27/01	Storage Device Capacity Management

### Education

<u>Year</u>	<u>College/University</u>	<u>Degree</u>
1983	Santa Clara University, Santa Clara, CA	MS, Electrical Engineering
1976	San Jose State University, San Jose, CA	BS, Electrical Engineering (with Distinction)

### Publications

1. B. Kim, D. Adams, Q. Tran, Q. Ma, V. Rao, "Scanning probe charge reading of ferroelectric domains," Appl. Phys. Lett., v. 94(6), 063105, 2009.
2. B. Kim, D. Adams, G. Tchelepi, Q. Tran, Q. Ma and V. Rao, "Scanning Probe Charge Reading of Ferroelectric Polarization with Nanoscale Resolution," 2009 NSTI Nanotechnology Conference and Expo, May 3-7, Houston, TX, (2009)
3. D. Adams, N. Belov, T-K. Chou, J. Heck, B. Kim, G. Knight, Q. Ma, V. Rao, G. Tchelepi, "Nanochip: A MEMS-based Ultra-High Data Density Memory Device," 2009 NSTI Nanotechnology Conference and Expo, May 3-7, Houston, TX, (2009).
4. N. Belov et al., "Thin-layer Au-Sn solder bonding process for wafer-level packaging, electrical interconnections and MEMS applications," Int. Interconnect Technology Conf., Sapporo, June 2009.

## **Consultant Curriculum Vitae**

5. S. Severi et al., "CMOS compatible poly-SiGe cantilevers with read/write system for probe storage device," Transducers 2009, Denver, June 2009.
6. N. Belov, D. Adams, D. Ascanio, T-K. Chou, J. Heck, B. Kim, G. Knight, Q. Ma, V. Rao, J.-S. Park, R. Stark, G. Tchelepi "Nanochip: A MEMS-based Ultra-High Data Density Memory Device," Advanced Technology Workshop "Advanced Materials and Technologies for Micro/Nano Devices, Sensors and Actuators, St.-Petersburg, June 2009.
7. D. Adams, N. Belov, T-K. Chou, J. Heck, B. Kim, G. Knight, Q. Ma, V. Rao, G. Tchelepi, "Nanochip: A MEMS-based Ultra-High Data Density Memory Device" – *future publication in "Sensors and Transducers."*

### **Professional Associations and Achievements**

- Member, IEEE
  - Eta Kappa Nu, Electrical Engineering Honors
  - Registered Professional Engineer in Calif. # E19198
- 

### **Adams & Associates**

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# APPENDIX 2

## **Documents Considered**

### **Pleadings and Deposition Transcripts**

July 26, 2017 30(b)(6) Deposition of Glen Almgren.  
September 7, 2017 Personal and 30(b)(6) Deposition of Patrick Dewey.  
September 8, 2017 Deposition of Andrei Khurshudov.  
December 15, 2017 Deposition of Andrew Hospodor  
June 30, 2017 Declaration of Alan Ng (Case No. CGC-15-547787)  
June 30, 2017 Declaration of Dave Rollings (Case No. CGC-15-547787)  
January 5, 2018 Declaration of Mary Paneno (Case No. 3:16-cv-00523-JCS)  
January 5, 2018 Declaration of Patrick Dewey (Case No. 3:16-cv-00523-JCS)  
January 5, 2018 Declaration of Glen Almgren (Case No. 3:16-cv-00523-JCS)  
January 5, 2018 Declaration of Harrie Netel (Case No. 3:16-cv-00523-JCS)  
January 5, 2018 Declaration of Lien Payne (Case No. 3:16-cv-00523-JCS), and exhibits thereto  
January 5, 2018 Declaration of Jeff Fochtman (Case No. 3:16-cv-00523-JCS), and exhibits thereto  
January 5, 2018 Declaration of Karl Schweiss (Case No. 3:16-cv-00523-JCS), and exhibits thereto

### **Books and Websites**

*An Introduction to Applied Probability*, Ian F. Blake, 1979  
National Institute of Standards and Technology ("NIST")/SEMATECH e-Handbook of Statistical Methods, <http://www.itl.nist.gov/div898/handbook> see also <http://www.itl.nist.gov/div898/handbook/apr/apr.htm>  
"Life Data Analysis Reference" produced by ReliaSoft Corporation in Tucson, Az., 5/22/2015 <http://www.ReliaSoft.com>  
<http://www.weibull.com/basics/parameters.htm>  
<https://www.seagate.com/global-citizenship/iso-9001-certification/>.  
Backblaze, *See What Can 49,056 Hard Drives Tell Us? Hard Drive Reliability Stats for Q3 2015*, (Oct. 14, 2015), <https://www.backblaze.com/blog/hard-drive-reliability-q3-2015>.  
Backblaze, *CSI: Backblaze – Dissecting 3TB Drive Failure* (April 15, 2015), <https://www.backblaze.com/blog/3tb-hard-drive-failure>.  
Backblaze, *How long do disk drives last?* (Nov. 12, 2013), <https://www.backblaze.com/blog/how-long-do-disk-drives-last/>.  
Backblaze, *What Hard Drive Should I Buy?* January 21st, 2014, <https://www.backblaze.com/blog/what-hard-drive-should-i-buy/>  
Backblaze, *180TB of Good Vibrations – Storage Pod 3.0*, February 20th, 2013, <https://www.backblaze.com/blog/180tb-of-good-vibrations-storage-pod-3-0/>  
[https://www.weather.gov/epz/wxcalc\\_rh](https://www.weather.gov/epz/wxcalc_rh)  
<https://www.nytimes.com/2015/06/07/opinion/sunday/the-deadly-combination-of-heat-and-humidity.html>  
<http://advances.sciencemag.org/content/3/8/e1603322.full>

**Produced Documents**

FED\_SEAG0000476  
FED\_SEAG0001817  
FED\_SEAG0001851  
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FED\_SEAG0001986  
FED\_SEAG0002109  
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